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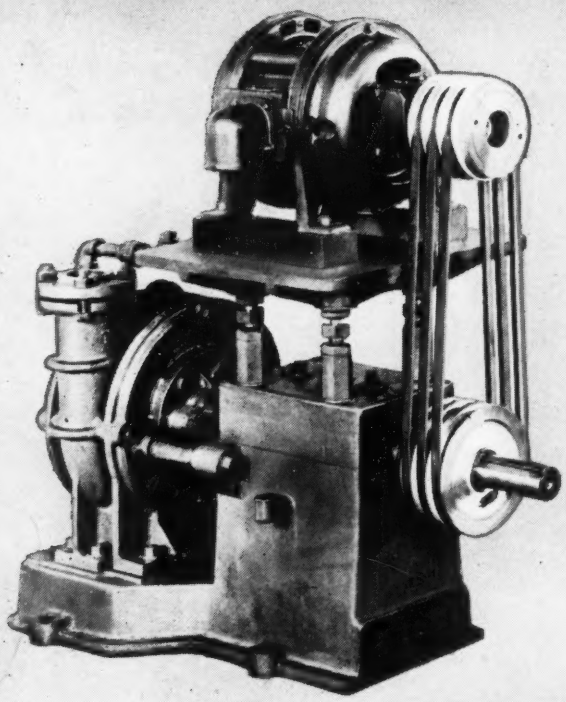
ENGINEERING AND MINING JOURNAL

JULY, 1943

WAR BONDS
AND STAMPS
FOR VICTORY



The war-born need for steel and more steel influenced the re-opening of an old New York State Iron Mine and the installation of modern ore beneficiation equipment to handle relatively low grade ore. Originally, three Hydroseal Sand Pumps with Overhead Motor Drive were ordered, two to handle 1260 G.P.M. of Thickener Overflow against a total dynamic head of 83 feet, and one to handle 615 G.P.M. of Iron Concentrate Thickening Cone Overflow against a T.D.H. of 85 feet. . . . A few months after the original order was placed, this mining company ordered two more Hydroseal Pumps. . . . Later, they ordered 4 more Hydroseals, three to be installed in series (one standby) to handle 1400 G.P.M. of tailings against a T.D.H. of 165 feet. . . . Quite a large number of Hydroseal Pumps are installed or are "on the way" for the re-opening or expansion of eastern state iron mines, and for new mining projects in the United States and the United Nations. . . . Address the nearest office listed below for Catalog No. 140; then, you supply the Priority and we'll supply the pumps.

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A.S.&R.'s decades of experience in producing refined metals have culminated in the acquisition by the smelting company of an electrolytic zinc plant in Texas, on the Gulf Coast—a lifetime ambition realized, so to speak. Working on concentrates from Mexico, the new refinery combines the best extant practice with certain innovations which have improved operations greatly. The story will be told next month by R. H. Ramsey.

▼ ▼ ▼

Stockpiles of metals and minerals essential to national security may furnish that security for the future when this war is over, if Congress enacts the necessary legislation and provides the funds—and what a noble sum may be required! The subject packs a headache, as debate will manifest, but is not to be avoided on that account. See the timely article by Evan Just in this issue.

▼ ▼ ▼

Postwar market jitters caused by large stocks of this and that commodity might be avoided if the Elsing proposal were adopted that the metals be converted into huge monuments commemorative of the heroes of this war, to be reconverted into munitions only in grave emergency. Once built, such memorials would no doubt prove effective in tying the metals up, for a considerable time at least. But it is hard to picture Congress voting favorably on something at once so colossal and ideal.

▼ ▼ ▼

John S. Stewart, whose article on converter capacity (E.&M.J., May, 1936) has proved useful to many in the industry, makes another welcome contribution in this issue, describing a new type of blast furnace. Mr. Stewart has had considerable practice abroad—in Russia, Africa, and, more recently, in Yugoslavia, where he was consultant on the design and operation of the Trepca lead smelter and refinery, which broke all records for ore hearth smelting.

ALFRED M. STAEHLE
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R. M. WARD
Manager

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Editor

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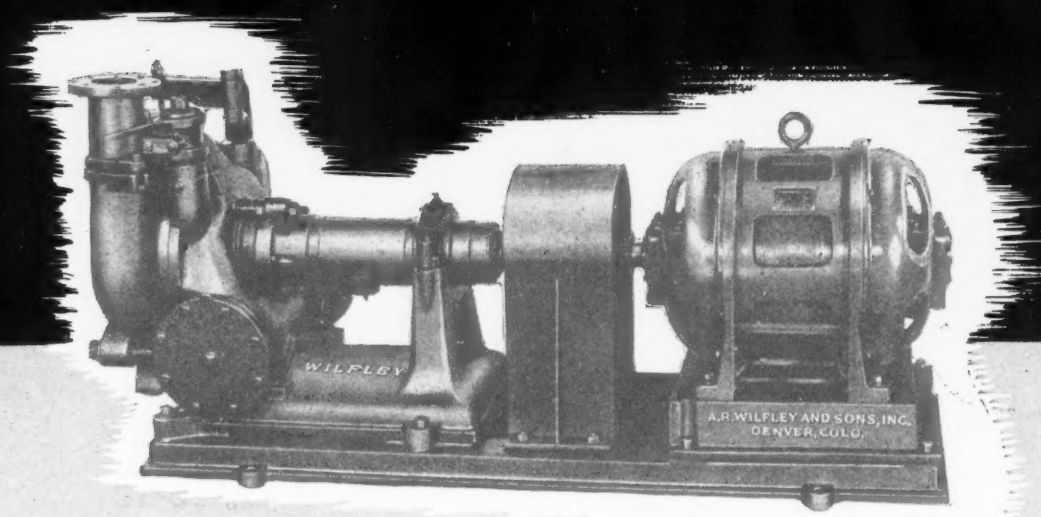

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Engineering Design
—Creator of America's Mechanized Might

In war, as well as in peace, the design engineer is the vital link between the inventive mind and the mass-production reality

It is gratifying and interesting to note that reports of new "secret weapons" not only have reversed their course during the past few months . . . they also have increased in frequency. Once they filled us with dread and misgiving. Today the enemy does the worrying.

Word about the latest new Army weapon reached us as this was being written . . . a 2½ ton truck that performs on water as well as on land with equal efficiency. "The Duck", resembling an overgrown amphibious jeep, is particularly suited to landing operations where docks are lacking. Loaded with 20 fully equipped soldiers or their equivalent in supplies, its propeller runs it ashore. It climbs the beach on its six-wheel drive and continues the trip on land.

This important addition to our "second-front" fighting equipment, coming so closely on the heels of the now famous tank-killing "Bazooka", is one of many history making contributions of American design engineers — the men who transform nebulous ideas into practical realities — the men who make our war machines superior to those of our enemies.

Invasion and eventual victory became a certainty as soon as America's design engineers threw their full effort into the war against aggression. Adapting intricate ordnance designs to mass production, these men developed weapons such as the M-10 destroyer of Rommel's tanks and brought out the new fighting planes and bombers that have won the air superiority that has turned the tide against the Axis. Taking ideas and giving them form, selecting the materials of construction, deciding upon the method of fabrication, adapting the electrical and mechanical parts that power the product, specifying the finish that protects and beautifies it . . . these men are the focal point of American production. Their ingenuity has no parallel. Once they put automobiles on a mass production basis and within the reach of all. Today, after less than three years and with little previous experience in armament design, they have brought America's war weapons to the highest efficiency . . . surpassing Hitler's weapons despite all the vaunted scientific wizardry of the Germans and their ten year start.

At this point it is well to remember that while Germany's military might is traceable to its superiority in armament, many of the basic technological discoveries (including the airplane and the submarine) are the products of American genius. The Germans always have been aware of the military advantages of technological superiority and have forced its expansion with all their might. They knew that mobility and surprise play a decisive role in modern warfare and their design engineers were kept busy, with unique intensity, to achieve unprecedented results in fast-moving, hard-hitting fighting equipment. Our own military and industrial engineers did not go into action until it became certain that we would be involved in the conflict. But even before our country actually embarked on its Preparedness Program they were busily engaged in developing the designs of our war equipment. Tanks, planes, guns, ships and hundreds of other apparatus and machines of war were studied. Carefully selected committees of our national engineering societies were organized under the leadership of the Army Ordnance Department to serve as advisors and consultants in the development of advanced designs of tanks and other motorized equipment of war. The above mentioned "Duck" and the now famous Sherman tank are just two of the many results of these efforts.

After the Preparedness Program had officially been launched and Congress had made its initial appropriation, it was necessary to create the manufacturing blueprints from which the engines of war could be built. Because the designs of the machines of production, as well as the designs of the products themselves, determine the speed and economy with which anything can be manufactured,

This is the thirteenth of a series of editorials appearing monthly in all McGraw-Hill publications, reaching more than one and one-half million readers. They are dedicated to the purpose of telling the part that each industry is playing in the war effort and of informing the public on the magnificent war-production accomplishments of America's industries.

the capacity of our industrial system is dependent, to a considerable extent, upon the ability and ingenuity of American design engineers. Germany's military might was successfully mechanized because Germany, for more than 10 years preceding the war, was riding the wave of a world-wide technological revolution. This revolution was as far-reaching as the advent of the electric motor and the internal combustion engine. It was born of the profusion of inventions and discoveries since the last war. German design engineers took advantage of every one of these.

If we are to defeat our enemies and if we are to continue to play the leading role in the post-war world we must make better use of the new technology than do our enemies. The job is up to American product engineers who already have made tremendous strides in designing the intricate machinery of production and of war equipment. Much remains to be done however.

It has been said that the Germans have not developed one single item that can be classified as basically original, nor are there indications that any so-called "secret weapon" will henceforth be developed by them. Today the Nazis are completely outclassed by the tremendous manpower of engineering brains that is at the disposal of American industry. Although we were faced by the same fundamental problems of shortages in materials, manpower and time, our engineers not only solved these problems quickly and effectively, but they outstripped the enemy by the preponderant weight of talent which we were able to bring to bear upon our problems. As is evidenced by studies of the designs of captured German war equipment, our airplanes are faster, carry heavier loads, have superior protective armor and heavier armament. Our tanks, especially the Shermans, stand unmatched. Our tractor-mounted artillery excels theirs in fighting power. Our automotive vehicles are the envy of the world. Our battleships are supreme. Our signal and detection devices are frustrating all of our enemies' attempts to dominate the seas.

And as we approach the end of the conflict, the pattern of which already has been set, the forces that converted American industry from peace to war-production will again be brought into play, and the product engineer will continue to be the fulcrum. Our post-war industry will grow from his blueprint. Nor will his job be any less urgent, any less responsible, any less sweeping in its effects than were his efforts during the war-preparedness program.

Since the cessation of the manufacture of peace-time goods, many new materials and production techniques have been developed. Plastics, synthetic rubber and magnesium in the field of materials were relatively new and restricted in their uses when war came. So were powder metallurgy, induction heating, electrostatic heating, adhesives for joining metals and compressed resin-impregnated wood. The new possibilities in product design created by the electronic devices and applications developed during the war period virtually stun the imagination and the "atomic revolution" promises to change the entire pattern of manufacturing operations.

Never before has there been so much speculation about the future as there is today. Looking forward, who can doubt our limitless capacity to continue our industrial world leadership?

While no one can predict developments in product design in the post-war period, certain it is that they will be so vastly different and so far superior to existing designs that they will obsolete most products as we know them today. With engines of vastly superior metals, designed to burn 100 octane gasoline and built to a precision ten times greater than that of pre-war engines, our post-war automobiles will give from 40 to 60 miles to the gallon. Tires will last from forty to fifty thousand miles. The comfort and smoothness with which these cars of tomorrow will glide along are undreamed of today. Polaroid windshields will eliminate the glare of oncoming headlights and the driver will need to give but scant attention to the manipulation of his simplified gear shifts.

According to no less an authority than Igor Sikorsky, we stand on the threshold of a new air age in which the helicopter will contribute to the greatest prosperity we have ever known.

Prophecies are hard to make at a time like this but speedy house building seems to be a certainty in the world of tomorrow. Air conditioning, new methods of heating, humidifying and drying, promise to be necessities in the post-war home. Vacuum sweepers will be much lighter, less noisy and easier to manipulate. Washing-machines will be fully automatic and practically free of noise and vibration. Not only will our homes and most of the furnishings be of radically new design, but so will the factories and machines that produce them.

Only one factor can prevent the fulfillment of the dream of the product designer. His job is not accomplished over night. To convert sound ideas into production blueprints involves a great deal of time and money. The building of test models is an expensive and tedious procedure. An abundance of seed money is required to perfect the product, to develop mass-production methods and to bring it to fruition as a finished saleable product.

It is the patriotic duty of every industrial leader to hasten these developments so that the material benefits created by them may speed our progress along the road of abundance.

President, McGraw-Hill Publishing Company, Inc.

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H. C. PARMELEE, Editor

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The Home Front

CONFUSION seems temporarily to reign on the home front. Note the symptoms. Price control results in black markets. Food administration lacks centralized authority. The Department of Justice harasses producers. Congress rebukes the President sharply on labor and subsidy legislation. Economic stabilization fails to stabilize. Ajax Lewis defies the lightning and miraculously escapes electrocution. New Deal alphabetical agencies fall under the Congressional axe. Administration leaders clash publicly. Military police have to quell civil riots. The manpower muddle is still with us.

On the whole, not a happy situation—indeed, a veritable scourge of German measles and Japanese beetles—but one that should, nevertheless, be appraised in its relation to the war effort as a whole. Perhaps the iceberg analogy will give a truer picture and help to preserve correct proportions. Seven-eighths of the great mass is submerged, and only one-eighth visible. The latter is spectacular, catches the eye, holds the attention. But it is only the visible evidence of the fearsome power and might of the berg, no less real for being out of sight. So with the war effort: on the surface the bickering and confusion of a democracy trying to turn totalitarian; beneath, a truly magnificent record of industrial production that will shatter the Axis when the final collision comes.

All this is not to condone the confusion. It is emphatically to be deprecated and criticized in the hope of remedying some of the evils that really retard war production. True, that hope is rather remote because most of our domestic difficulties stem from New Deal economic and social policies, and from the Executive's recognized ineptitude in organization and management. To a large degree the troubles besetting the home front are New Deal chickens coming home to roost on the Administration's back fence. For example, if the President now finds John Lewis' action "intolerable," he cannot escape responsibility for having winked at equally subversive activities by that great patriot under the charter of the Wagner Act. If our civilian war agencies are ineffective, the reason is to be sought in Mr. Roosevelt's penchant for almost—not quite—delegating authority commensurate with responsibility; and creating one agency after another with indefinite and sometimes overlapping powers, leaving each to work out its own salvation. President Wilson's organization of the home front in the First World War was vastly better and more efficient than what we now have. But even now hope of improvement is not to be abandoned. Belated evidence of revolt and independence in Congress encourage one to believe that the temper of the people is being recognized and that their representatives may inject a few doses of sanity and reason into the domestic war economy.

Lend-Lease Operations

IN THE FIRST TWO YEARS of its existence the Office of Lend-Lease Administration has rendered aid to other of the United Nations, in the form of goods and services, to the value of more than eleven billion dollars, which is approximately twelve percent of the total war expenditures of the United States. Although lend-lease agreements have been signed with thirty-one nations, and fifteen others have been declared eligible for such aid, the bulk of the assistance has been given to the United Kingdom, Russia, Africa and the Middle East, and the group comprising China, India, Australia, and New Zealand.

Almost one-half of the aid extended has been in the form of munitions—planes, tanks, and guns. Food has accounted for between one-sixth and one-seventh of the total, and has been shipped principally to Russia and Great Britain for the armed forces of those countries. Substantial as the food aid has been, it has not been a heavy draft on the total supply in the United States. In 1942 the lend-lease export of food amounted to only six percent of our domestic supply, and is expected to rise to only ten percent for 1943. The figures effectually dispose of the unfounded statement that lend-lease shipments abroad have been principally responsible for the food shortage at home.

The reciprocal aspect of the lend-lease program is

steadily growing in importance as more United States forces are quartered in foreign countries. In the case of Australia, reciprocal lend-lease operations just about balance our aid to that country. American forces in the British Isles are receiving substantial supplies and services that can be provided on the spot, without payment by the United States. These arrangements make unnecessary the transportation of hundreds of thousands of tons of supplies that otherwise must take up precious cargo space. Incidentally, less than five percent of lend-lease shipments have been lost by enemy submarine action, mostly on the Murmansk route.

Although the most valuable single contribution of lend-lease to Russia has been finished weapons, a close second in importance has been metallic raw materials to be fabricated in Russian industrial plants. Up to April 30, 1943, the mineral and metal industries of the United States had shipped to Russia 725,000 tons of steel and steel products, 145,000 tons of copper, brass, nickel, molybdenum, and other materials, 60,000 tons of aluminum and duralumin and 32,000 tons of zinc.

On the whole, lend-lease has proved a convenient and effective device for achieving maximum production and distribution of munitions, industrial commodities, agricultural products, services, and supplies among the United Nations, and has been a powerful factor in the prosecution of the war. That its administration has been honest, sound, and efficient is attested by the fact that the Congress has accepted its programs and granted the desired appropriations without dissenting voice.

Bureaucracy—Industry's Arch Enemy

THE COURSE OF THE COAL STRIKE causes us to repeat a truism which nobody takes the trouble to contest, but which few take to heart—namely that industry is, or should be, a partnership of labor, capital, and management, not a battlefield.

We believe that if labor and capital-management should really understand the inevitable consequences of continued strife among themselves—complete government control and operation—each would automatically be not only willing but anxious to get together in a spirit of greater cooperation. Out of government control nothing beneficial to either labor or capital-management can possibly accrue. It will simply fasten on the productive personnel of industry an army of bureaucratic parasites to suck away industry's capacity to improve or even maintain wages, profits, and efficiency.

Any improvement in the fruits of industrial activity must be obtained through improved efficiency. Efficiency and politics are mutually repellent. The lesson of centuries is that the last concern of bureaucracy is efficiency. Therefore, we sincerely hope that both labor and capital-management will take fright and compose their differences soon enough to prevent any further justification for government encroachment on industrial activity. Even so, the advancing juggernaut of government control may already have gained too much momentum to be controlled or stopped.

Badgering the Producers

THE RECENT INDICTMENT of National Lead and du Pont for alleged participation in titanium cartel activities before the war will further damage the morale of parties who regret a government policy of continuing to badger and harry producers who are making sincere and valuable efforts to help win the war.

The federal prosecutor stated: "Because of cartels, strategic industries restricted production before Pearl Harbor and enormously increased the difficulty of transforming our economy into the arsenal of democracy. In a whole roster of industries—light metals, synthetic rubber, military optical goods, machine tools, precision instruments, plastics and synthetic medicines—years of restraint imposed by cartel agreements created severe and acute shortages."

If the prosecutor was not inferring that the titanium producers created such shortages, his statement had no place in this case. Nevertheless, F. W. Rockwell, president of National Lead, insisted that the titanium producers had met all the demands of the United Nations.

The government prosecutor went on to state: "Failure to eliminate cartel control of the world economy may well lose the peace, for if cartel activities are not stopped before peace comes, they will help create world-wide unemployment and foster postwar depression." This seems like an inconsistent attitude on the part of government which forces production restrictions and prices by fiat on the domestic coal and oil industries.

Mr. Rockwell's view is that business at present is given no alternative but to become completely anti-international and firmly isolationist. How this fits the Administration objectives of participation in international affairs is not easy to answer.

The editors of *Engineering and Mining Journal*, as stated on the editorial pages of the May issue, cannot perceive how we can prevent postwar chaos and unemployment in the mineral industry without intelligent and fair cartelization to foster stability. Nor can we see how American industry can do its war job if it is continually distracted by suits of doubtful validity. Someone should inform the Department of Justice that the United States is engaged in a bitter war that commands all the country's talents and resources, and suggest postponing anti-trust suits for the duration.

Reflections from Washington

Washington News Bureau

NUMBER ONE FEAR in Washington is the public's growing belief that the Army, Navy, and Maritime Commission are over-shooting in planning their requirements and that the time has come when the war effort can ease off in favor of peacetime activities. Evidences of public complacency are a cause for real alarm among high production officials. It is a feeling that has even hit the Army, according to General McNair, who said on his return to active duty that the success of the Tunisian campaign had bred overconfidence among the troops. A situation has developed that threatens the entire production program.

Undersecretary of War Patterson has shifted his attentions from Rubber Czar Jeffers to the lagging production program. The Army high command is disturbed by the decline of 3½ percent that occurred in May instead of the scheduled 2 percent rise. Warned the Undersecretary: "Management and labor must deliver the supplies on schedule and as planned or the opportunity to exploit recent military successes will be lost. I would attribute the letdown in May to overconfidence inspired by the Tunisian victory and the success of the European bombing; to baseless rumors of vast quantities of Army supplies being stored up here in America far beyond our abilities to transport overseas, and to the mistaken belief on the part of many that materials in great quantities will shortly become available for the conversion of many war facilities to the less essential civilian production."

Expanding Schedule Demanded

GOAL OF THE SERVICES in 1943 is a production of war material amounting to 83 billion dollars. To reach this figure the rate of production in the last half of the year must be 50 percent greater than it was in the first half. The temporary goal for 1944 calls for an increase of at least 25 percent over this year's effort. As the appropriations are passed by Congress the contracts for this production are being let. Neither management nor labor need fear cutbacks. Though it is true that some munitions have been piling up, the shooting war is yet to come. From a military standpoint the country is fortunate to have these surpluses.

Figures for production in the first half of the year are not yet available, but estimates put it at about 41 percent of the year's goal. On a rising production curve this is not so bad as might appear. It is apparent that production in the first quarter must have been below 25 percent of the annual goal and the expectation is that considerably more than 25 percent of the goal will be produced in the last quarter. Actually first quarter figures showed about 19 percent, with second quarter estimated to be about 22 percent. This is the basis for statements that production in the last half of the year will have to be 50 percent greater than in the first half if the production goals are to be reached.

Steel, Copper and Gold

SHORTAGES of two metals, copper and steel, pose a serious problem receiving the personal attention of top WPB officials as the first half of the year ended. The steel industry has been asked to produce an additional million tons of high-carbon ingots during each of the last two quarters of this year. This steel is earmarked for the production of agricultural equipment, food-processing equipment, railroad maintenance, and other vital purposes, and if it is not forthcoming it might become necessary to take some material scheduled for the production of machinery used in other industries. The mining industry has been allocated ample material for the third quarter, but failure to produce the additional steel might cause a cutback in the fourth quarter.

Belief that the additional million tons of steel can be produced is based on the continued success of the scrap drive. The expansion program in the steel industry included an excess of blast-furnace capacity to produce synthetic scrap. This excess capacity plus a greater use of hot metal and other advanced production practices, the reconversion of open-hearth facilities to production of carbon steel and the fact that the expansion program as a whole is well ahead of schedule, make possible the production of the additional million tons.

Copper production in 1943 must be increased 10 to 20 percent over that of 1942. Manpower is the biggest stumbling block to real progress. Unofficially it is claimed that the transfer of miners from the closed gold mines to the copper mines has resulted in a substantial increase in tons of copper produced since the first of the year amounting to well over five figures. Specific information and data to support these claims are not available. At best the estimate represents only a fraction of the tonnage that must be produced if the pace is to be maintained.

In rejecting demands for the modification of the order closing the gold mines, WPB said that at least 1,200 gold miners had been transferred to non-ferrous metal mines. Critical materials saved by the order were placed at $75,000,000.

The War Production Board did clarify the regulation under which operators could apply for exemption. Appeals may be made if a sufficient labor supply may be secured without drawing on the supply of any essential war activity. Appeals may also be made if the output of critical material from a particular mine makes a larger contribution to the war effort than would be made by the materials and labor involved if used in some other manner in the industry.

Manpower Programs

THREE PROGRAMS are under way to improve the labor situation in the non-ferrous metal mines. One of the programs is designed to keep the miners on the jobs they now hold. It is being formulated by the Non-Ferrous Metal Subcommittee of the Production Information Committee, the latter being made up of information specialists of the various war agencies.

The second program is an intensive drive to recruit men in Region 11, the mining area of the West, to work in the non-ferrous metal mines. This drive is under the auspices of the War Manpower Commission.

The third labor program is being carried on out of San Francisco and aims to persuade miners who have left the mines to work in the war plants on the west coast to return to the mines. It is claimed that if this latter drive is successful the shortage of mine labor will be materially reduced. Labor and management in the west coast war plants are cooperating.

A fourth program is now being considered. It is a plan to recruit labor for the non-ferrous mines in certain

(Continued on page 81)

INTENSIVE EXPLORATION and development over a period of five years brought Morenci's Clay Mountain orebody to the stage shown at right. Thirteen 50-ft. benches have been blasted out and ultimately about 230,000,000 tons of ore and an equal tonnage of waste will be removed

Morenci Expands

To Meet War Demand

Foresight in planning facilitates step-up in production

John B. Huttl, *Assistant Editor*

CALL IT FORESIGHT, sound economics, plain luck, or what you will, the fact remains that when Phelps Dodge Corporation in the fall of 1937 decided to begin mining the Clay orebody at Morenci, Ariz., a major victory for the United Nations was won in a war which at that time hardly more than clouded the horizon. With the country still pulling in low gear out of the pit of depression, Louis S. Cates and the directors of Phelps Dodge had to have courage to launch a $35,000,000 enterprise, and they made sure that this, the first major copper development in Arizona in 30 years, would be as well planned and well equipped as human ingenuity, experience and determination could make it.

Five years of planning, exploration, testing, and construction went into the Morenci enterprise, and few of the world's large mines have had such exhaustive attention paid to every detail of their design. Here, again, it is fortunate that this was so, for even before the new smelter poured its first copper in April, 1942, the WPB called on Phelps Dodge for an 80 percent expansion in output. Even this had been anticipated, and the plans were ready. As a result, Morenci will soon be adding well over 100,000 tons of copper annually to the weight of metal with which we will eventually win this war. The technological achievements and skillful use of equipment which make this contribution possible appear in the following discussion.

Arizona's Morenci district has a long and an interesting history. Early operations, dating to before 1873, consisted of mining high-grade ore available at comparatively shallow depths, but as metallurgical methods and machinery improved, leaner ores were tackled by various operators, Phelps Dodge Corporation entering the district in 1881. Other companies conducting what were then considered large-scale operations included the Arizona Copper Company, Detroit Copper Mining Company, and the Shannon Copper Company. In 1906 the two first named operated concentrators capable of handling 900 and 1,000 tons a day respectively, and smelters were available at Morenci and Clifton. In 1921, Phelps Dodge Corporation acquired ownership of all mineral holdings in the area, subsequently centering all activities in the Humboldt mine, at Morenci. Production was gradually increased to more than 4,000 tons a day, and concentrates produced by flotation were reduced in the Clifton smelter.

During this period exploration of the Clay orebody and other claims adjacent to the Humboldt holdings led to the development of a large mass of low-grade ore averaging a little more than 1 percent copper. Work was done by surface and underground churn drilling, and drifting and raising. After repeated checking of tonnage, grade, and the economics of exploitation it was decided to work the orebody by open-pit methods. Arrangements for financing the enterprise were completed early in 1937, and preliminary pit excavation work commenced soon thereafter.

Metallurgical investigation to determine the flowsheet of the proposed 25,000-ton concentrator was started after ore was exposed in the pit area under development. The broken ore was trucked to No. 6 concentrator, a short distance from the pit, where large-scale metallurgical tests were

made, and different types of grinding, classifier, and flotation equipment tried out. Preliminary work carried out in the pit area included construction of haulage roads, railroad grades, and establishment of mining benches. The exceptionally rugged terrain presented many construction and surveying problems. Standardization of the 10-mile narrow-gage track between Clifton and Morenci, and construction of a modern surface plant near the pit, were additional tasks completed before commencement of actual pit development.

The porphyry orebody currently under exploitation is 850 ft. high, and contains an estimated 230,000,000 tons of 1.06 copper ore. Average thickness of the overburden is 220 ft. At an estimated 1:1 ore-waste ratio, more than 230,000,000 tons of waste rock will be removed during exploitation of the ore zone proper. When fully developed, the pit will be 5,800 ft. long and 4,000 ft. wide, and the vertical range of mining more than 1,300 ft. Initial development involved removal of some 50,000,000 tons of material, including 2,000,000 tons of ore sent to No. 6 concentrator for testing. Early bench work was done by earth-moving units, each consisting of 4½-cu.yd. full revolving electric shovel, 22½-cu.yd. diesel trucks, and a large bulldozer to keep the roadway clear. The trucks are credited with hauling a total of 30,000,000 tons.

When development reached the center portion of the pit, established benches and switchbacks were equipped with rail haulage, both diesel-electric and trolley-battery locomotives being used. The track section between the pit and the crushing plant has been electrified. On single track the overhead trolley wire is carried on bracket supports attached to wood poles; wood poles with cross-catenary supports are used on double-track sections. At the time of my visit, in March of this year, there had been removed from the pit more than 85,000,000 tons of material, five waste dumps had been established, and work was proceeding on 14 benches between the 5,400 and 4,700 levels. Six of the benches are in ore, with the 4,950 level marking the top of the orebody.

On the established benches primary drilling is done with electric churn drills using 9-in. bits. Pneumatic drills and special toe-hole drills are employed in block-holing and toe-holing operations. On preliminary development projects such as haulage roads, railroad grades, and initial hillside benches, wagon drills and heavy jackhammers suspended from steel tripods are used. Benches are carried at a uniform height of 50 ft. Churn drill holes are drilled to 8 ft. below the shovel level. Spacing is 15 ft. from the crest of the bench and 15 ft. apart. Broken material is cleaned up by the shovel to hard face, followed in some cases by toe-holing to obtain a vertical bench for blasting.

General blasting practice is to fire simultaneously from 40 to 60 churn-drill holes loaded with 40 percent Special Gelatin prepared in 50-lb. cartridges measuring 8x18 in. These are lowered singly to the bottom of the hole (not sprung) by a special loading device, and finely crushed ore is used for subsequent stemming. The normal 500-lb. charge is detonated with Primacord. No. 8 electric blasting caps and 40 percent Special Gelatin dynamite are used in secondary blasting. A check on ore values is obtained by sampling the cuttings from churn-drill operations on the ore benches.

Loading equipment employed on the benches has been more or less standardized, all units being of the 4½-cu.yd., full-revolving type using electric power at 2,300 volts. Average shovel production per eight-hour shift is 4,500 tons. In the topmost section of the pit broken material is hauled in 22½-cu.yd. diesel trucks, on the waste benches by 30-cu.yd. steel side-dump cars and 1,000-hp. diesel locomotives, and in the lower part of the pit or ore zone by 40-cu.yd. steel side-dump cars and 1,325-hp. combination battery-trolley locomotives equipped with 240-cell, 500-amp.-hr. units. The batteries are charged automatically every time the pantograph is in contact with the trolley wire. Four mercury arc rectifiers convert 13,800-volt, three-phase, 60-cycle power to 860 volts d.c. for use in the trolley system. Waste generally is hauled to the dumps in trains composed of nine 30-cu.yd. cars. Ore is delivered to the crushing plant, about 2½ miles from the pit, in trains made up of ten 40-cu.yd. cars.

Loaded ore trains are transported from the benches to the primary crushing plant first over a switchback system constructed on a 4 percent compensated grade for about 2 miles, and over the main track laid on a 0.4 percent grade for 1½ miles. A maximum curvature of 10 deg. is allowed on the switchbacks, and 6 deg. on the main track. About 85 percent of material handled currently moves over favorable grades. The main track leading to the reduction plant site is a piece of work of which the engineering department can be proud. It follows along a number of quartzite bluffs 200 ft. high, and initial construction presented many survey and excavating problems. The preliminary roadbed was advanced on a relatively heavy curvature, which was periodically straightened out as the waste

fill areas or dumps at different points along the line increased in length and width.

Traffic on the main haulage system is regulated by means of a hand-operated signal system controlled from a central tower on a small hill at the pit entrance. As mentioned previously, five dumps are currently available for waste disposal. Established at 100-ft. vertical intervals, each dump serves two benches, of which the upper one is reached by a 3½ percent connecting track. Loaded waste trains are hauled to the dumps over a network of tracks on a 0.25 percent grade running in an opposite direction from the ore movement. Average haulage distance is about 2½ miles.

As to track construction, the main lines are made up of 131-lb. rails resting on 8x10-in. treated pine ties. Bench and dump trackage consists of 90-lb. rails laid on 7x9-in. ties. Switch units used on the main lines have 16½-ft. switch points and No. 9 manganese-steel frogs with one-piece guard rails. Those on the secondary lines are of similar design, but use 15-ft. switch points. Ballast on the permanent tracks consists of smelter slag, of which an abundant supply is available near the pit.

An interesting feature on the benches is the wide use of track panels. These are made up and repaired at a special yard a short distance north of the pit, and handled on the benches by a railroad crane. Track maintenance equipment in use includes bulldozers, dump plows, track shifters, track speeders, and others. Considerable attention is being given the network of roads serving the pit, in an effort to maintain maximum efficiency of the haulage and supply trucks, and reduce repair and maintenance work on them. Near the entrance of the pit are the modern shops for drill-tools, track machinery, including movable cranes, cars, and locomotive maintenance and repair; a garage; change room; an oil house; and a pit office.

The reduction works site is about 2½ miles from the pit. Primary and secondary crushing plants and concentrator are situated at the northern end of the plant site, where a natural slope provides adequate fall through these units; and the level section extending to the south contains the smelter and bedding plant, power house, machine shops, warehouse, and tailings dewatering plant. As expressions of sheer creative engineering ability, the plants have few equals anywhere, and the extent to which foresight has been exercised throughout the entire enterprise is most impressive. The crushing plants and concentrator are almost entirely automatic in operation, which has been accomplished largely by insuring a constant and uniform feed to the divers treatment units and by using modern equipment of ample capacity. The major buildings are accessible by rail and truck, and cranes available on the different floor levels, as well as elevators, facilitate secondary handling of materials, supplies, and equipment.

LOADING ORE TRAIN in the Morenci pit. Cars used are 40 cu. yd. side dump type, and locomotive is 1,325 hp. combination trolley-battery type. Nine 4½ cu. yd. full-revolving electric shovels are at work in the pit

Mine-run ore currently received at the reduction plant contains a little less than 1 percent copper, 3.6 percent iron, and 0.6 percent oxide copper. Chalcocite is the chief copper mineral. Treatment involves three-stage crushing, single-stage grinding, flotation, and regrinding, cleaning, thickening, and filtering concentrates as outlined in the accompanying flowsheet. The building housing the primary crushing equipment is of concrete and steel-frame construction and measures 73x110 ft. All machinery units are installed in the lower concrete portion of the structure. The steel housing covering the dumping floor contains a heavy crane with 10- and 25-ton hooks and a control panel. The plant is capable of handling more than 4,500 tons of ore an hour. On the dumping floor there is a separate service track to facilitate handling of supplies and equipment, and the floors below are served by a 5-ton freight elevator. Quick access to the ball-mill floor in the concentrator building is afforded by a concrete tunnel near the bottom of the crushing plant.

All rooms inside the building are air-conditioned, with the crusher drive room under slight positive pressure, and adequate dust control is provided at all points.

The crusher employed is a 60-in. gyratory unit running at 260 r.p.m. Diameter outside of the top flange is 20 ft., and total height 28 ft. The setting is 7½ in. At the dumping floor, each 40-cu.yd. side-dump car (air cylinders are hand-operated) is emptied into a pocket in the concrete crusher feed shaft, whence the ore flows in a reversed direction at lower speed first over a 6-in. steel grizzly set at an angle of 40 deg. and then into the crusher proper. The crusher product and the grizzly undersize are fed by two inclosed 72-in. by 38-ft. manganese-steel pan feeders onto two 54-in. belt conveyors discharging through trippers into the 13,000-ton coarse-ore bin at the head of the secondary crushing plant. Both belt conveyors are alternately operated loaded and empty at set time intervals to suit the dumping cycle. As the capacity of the primary crushing plant is large enough to supply a 45,000-ton concentrator, no extension will be made.

Ore is moved from the primary bin to the secondary crushing plant by eight pan feeders and two 60-in. belt-conveyors with magnetic head pulleys. Reduction to mill-feed size, or ¾-in., involves crushing in standard and short-head cone crushers, with electric vibrating screens in open circuit between them. To explain in detail, the ore brought to the plant is passed over two 6x14-ft. rod deck vibrating screens set at an angle of 22½ deg. and covered with 1¼-in. rods, 2-in. openings, the oversize going to two 7-ft. standard cone crushers set 1½ in., and the undersize crusher product to eight 5x10-ft. rod deck vibrating screens set at an angle of 25 deg. and covered with ½-in. rods, 11/16-in. openings. Oversize from the secondary screens is reduced in four 7-ft. short-head cone crushers set ¾ in., and the undersize together with the crusher product is transported to the 16,000-ton secondary bin at the concentrator by a

54-in. main belt conveyor equipped with a movable tripper at the discharge end. Two additional crushing sections are in course of installation at the secondary crushing plant in accordance with the general expansion program.

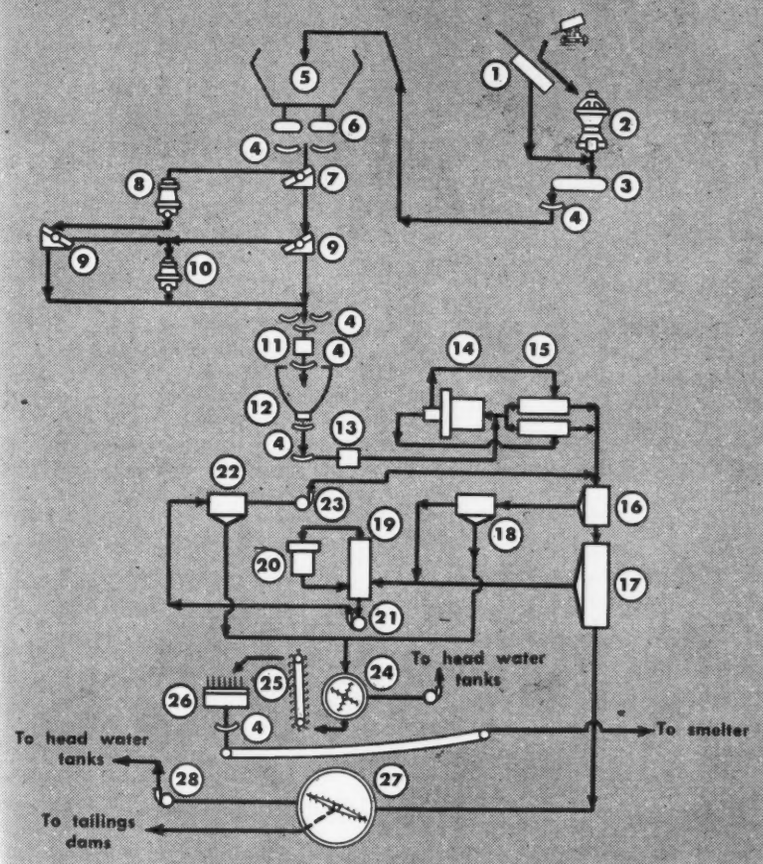
The secondary steel storage bin at the concentrator is of the suspension bunker type, and filling rate provided by the conveying equipment currently in use is 2,500 tons per hour. Ore withdrawn through a series of flat rack-and-pinion cutoff type discharge gates at the bottom of the bin drops onto 36-in. belt feeders driven by variable-speed motors serving 24-in. conveyors leading to the top of the scoop boxes of the ball mills. Four discharge gates are provided for each ball mill, to insure uninterrupted withdrawal of ore. Each 24-in. conveyor is equipped with a weightometer, which controls the speed of the 36-in. conveyors under the bin automatically. Grinding to 3.5 percent plus 65 mesh is done in one stage by sixteen 10x10 ft. grate mills running at 18 r.p.m. and driven by 800 hp. synchronous motors. Each mill operates in closed circuit with two 54-in. duplex submerged spiral classifiers.

Classifier overflow at 19 percent solids and an alkalinity of 1.5 gr. CaO/gal. goes successively to a primary rougher flotation section consisting of 80 66-in. Fagergren level-type cells and a secondary rougher flotation section of 160 66-in. level-type cells. Tailings from the secondary rougher section flow to four 300-ft. traction thickeners, from which underflow at 45 percent solids goes to the dams. Overflow is pumped back to the headwater tanks by five 5,000-g.p.m. centrifugal pumps.

Concentrates produced by the primary rougher section are re-treated in 40 56-in. level-type primary cleaner cells, the resultant froth going to two 100-ft. torque thickeners, and the tailings, together with the froth from the secondary rougher units, are reground in three 8½x12-ft. overflow type ball mills in closed circuit with three 54-in. spiral classifiers. The classifier overflow, 80 percent minus 350 mesh, 15 percent solids, alkalinity of 10 gr. CaO/gal., is pumped by 8-in. sand pumps to 52 56-in. level-type secondary cleaner cells. Froth goes to the 100-ft. torque thickeners mentioned previously, and tailings are delivered to the head of the primary rougher flotation section by 8-in. sand pumps. Underflow leaving the torque thickeners at 65 percent solids is elevated by two bucket elevators using 30-in. belts and 14x8-in. buckets to four disk filters, each containing seven 8½-ft. disks, and the overflow is pumped back to the head water tanks by three 400-g.p.m. vertical turbine pumps. Dewatered concentrates are transported to the smelter bedding plant by a belt conveyor.

Reagents are fed at the following points: Lime, at the head of each ball mill, regrind mill, and primary cleaner cells; reagent 208 at the head of each ball mill; and cresylic acid at the head of the primary rougher cells. Ratio of concentration is about 30:1, and recovery 87 percent of total copper and 29 percent of iron. Concentrates sent to the smelter contain 22 percent copper, 5.5 percent insoluble,

FLOWSHEET OF MORENCI CONCENTRATOR PHELPS DODGE CORPORATION



LEGEND

1. Rail grizzly, 6 in. spacing
2. 60-in. Traylor Bulldog gyratory, 7½ in. setting
3. 2 72-in. S-A pan feeders
4. Conveyors
5. 13,000-ton bin
6. 8 48-in. S-A pan feeders
7. 2 6x14-ft. Ty-Rock rod deck screens, 2-in. openings
8. 2 7-ft. cone crushers, 1½ in. setting
9. 8 5x10-ft. Ty-Rock rod deck screens, ¾-in. openings
10. 4 7-ft. short-head cone crushers, ⅜ in. setting
11. Toledo-Chronoflo scale
12. 16,000-ton storage bin
13. 16 Toledo-Chronoflo scales
14. 16 10x10-ft. Marcy grate mills
15. 32 54-in. Akins duplex classifiers
16. 80 66-in. Fagergren primary rougher cells
17. 160 66-in. Fagergren secondary rougher cells
18. 40 56-in. Fagergren primary cleaner cells
19. 3 54-in. Akins duplex classifiers
20. 3 8½x12-ft. Vulcan ball mills
21. 6 8-in. Wilfley pumps
22. 52 56-in. Fagergren secondary cleaner cells
23. 8 8-in. Wilfley pumps
24. 2 100-ft. Dorr torq thickeners
25. 2 bucket elevators
26. 4 American filters, 7 8½-ft. discs
27. 4 300-ft. Dorr traction thickeners
28. 5 5,000-g.p.m. I-R pumps

and 31 percent iron. Tailings assay 0.12 percent copper. Fresh-water consumption per ton of ore treated is 175 gal.; power, 13.65 kva.; and labor, 101 per man-shift. The 50-ton ball charge in each mill is made up of 2- and 3-in. balls stored in convenient bins in the western end of the concentrator, where space is also provided for repair and relining of ball mills. Delivery is by means of small steel cars hauled by a battery truck operating on a track extending along the entire feed end of the ball-mill section.

Equipment available in the mill repair section includes welding units, drill presses, grinding units, and work benches. Lifting of materials is done by a 150-ton electric crane. Track spurs enter the concentrator building on the ball-mill floor and regrind-mill floor. Electric control panels for the entire concentrator are housed in a concrete structure, 130x25x10 ft., built under the central part of the ball-mill section.

Wide use has been made of Transite pipe and Transite tailings launders. The main launder handling final tailings is carried at $\frac{3}{8}$ in. to the foot in a concrete tunnel running below the rougher flotation floor to the distribution box at the dewatering plant. Here, the clear water from the four traction thickeners overflows into a central 1,000,000-gal. concrete tank, from which it is returned to the head-water tanks by the five centrifugal pumps mentioned before. The launder carrying the thickener underflow to the final tailings disposal site is 17,000 ft. long. It is on a $1\frac{1}{2}$ percent grade, and is made from Transite sections 54 in. wide and $21\frac{1}{2}$ in. deep.

Water reclaimed from the different dams is first pumped by a series of 1,000-g.p.m. pumps to a nearby 50,000-gal. steel tank, and then by other 1,000-gal. pumps through a 14-in. Transite pipe to the 1,000,000-gal. concrete tank at the dewatering plant.

Milk of lime prepared in a separate plant near the smelter is stored in three tanks with stirring mechanisms and a total capacity of 300,000 gal. near the concentrator, near which point also is a 144x40-ft. reagent storage building containing mixing and pumping machinery. Additional equipment in course of installation at the concentrator includes eleven ball mills with necessary classifiers, flotation machines, thickeners, filters, and auxiliaries.

The smelting plant is composed of the following units: Bedding plant, crushing plant, sampling tower, and the smelter proper. Transportation of materials from unit to unit is over a well-designed conveyor system using 20- and 24-in. belts. Concentrate reclaimed from the bedding plant is reduced in reverberatory furnaces, the resultant matte treated in horizontal converters, and the finished product cast into anodes for refining at the company's El Paso plant. The bedding plant contains three totally inclosed 8,000-ton beds served by overhead conveyors and mechanical excavating units, and storage facilities for flux and custom ores prepared at the crushing plant. Here, custom ores, siliceous ore, and lime rock for flux and preparation of milk of lime used in the concentrator are stored in a receiving ban accessible both by rail and trucks. Crushing equipment consists of a jaw crusher served by a pan feeder, followed by a vibrating screen, to a 7-ft. cone crusher for reducing converter flux to $\frac{3}{4}$ in., and a 4-ft. cone crusher for crushing reverberatory flux to $\frac{1}{4}$ in. The sample tower mentioned before is between the bedding plant and the crushing plant.

In the smelter building there are available two reverberatory furnaces, three Peirce-Smith converters, two anode-casting furnaces, and an anode casting wheel. Prepared concentrates containing about 9 percent moisture are fed raw—that is, without prior roasting—into the reverberatory furnaces. Now handling 600 tons of charge a day each, these measure 110 ft. by 31 ft. 3 in. outside the walls. Furnace walls are tapered, 1 ft. plus at the top and from 4 to 5 ft. at the bottom, and the arch is 20 in. thick, 35 ft. radius, 9 ft. above the furnace bottom, and horizontal for its full length. The furnace bottom is made up of a layer of poured slag about 8 ft. thick at each end of the furnace and 4 ft. 4 in. at the center. Save for the charging zone, construction of the arch and walls is of silica brick, lined with magnesite.

Side feeding is practiced. This is accomplished by two vibrating conveyors above the side walls of each furnace distributing material received from two 265-ton overhead bins to a series of charge spouts at 4-ft. centers along the ends of the roof. The discharge gates on the spouts are controlled by hand. Each furnace is fired by two groups of multiple-jet, low-pressure gas burners suspended from individual trolleys to permit their withdrawal whenever desired, and oil burners are provided for use in case of gas or burner failure. Waste-heat boilers are connected to the furnaces by a short uptake flue measuring $8\frac{1}{2}$x33 ft., the bottom of which slopes steeply back toward the furnace to facilitate drainage of slag. The magnesite roof and back wall are of suspended construction. A solid brick damper is available to cut out either boiler. Slag and matte are tapped from the side of the furnace. Transportation of

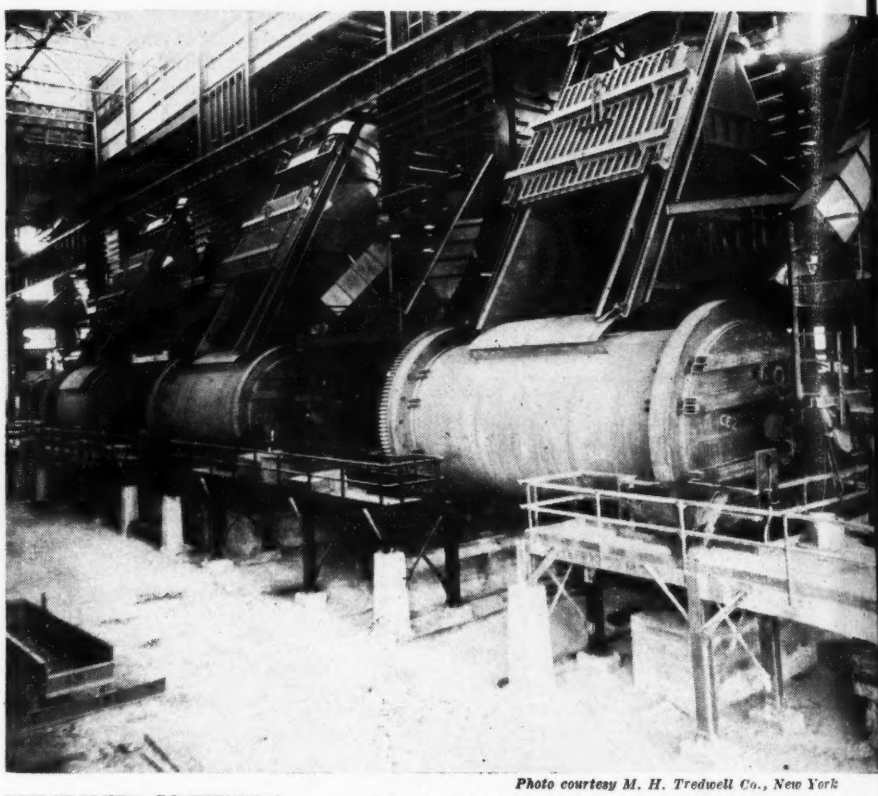


Photo courtesy M. H. Tredwell Co., New York

PEIRCE-SMITH CONVERTERS are used in the Morenci smelter. The three shown here 13 x 30 ft., are of all-welded construction, and are lined with magnesite brick.

CHALCOCITE FLOTATION is accomplished at Morenci with these Fagergren level-type flotation machines, an installation of 332 cells. Test work in a 1500 ton concentrator established applicability of all ore dressing equipment used at Morenci

slag to the dumps is done in 225-cu.ft. ladle cars drawn by an 18-ton electric locomotive.

Matte tapped from the reverberatory furnaces goes to the converters in 175-cu.ft. ladles handled by an electric crane with two 60-ton hooks. The crane is protected from overload by an automatic power cutoff arrangement, and the cabs are fully inclosed and air-conditioned. The converters are 13x30 ft., use 52 1½-in. tuyeres, and have a 13- and 18-in. magnesite lining. Movable hoods installed above the converter openings direct exit gases into the converter flue system. At the ends of each converter there is a flux storage and charging arrangement consisting of elevated storage bins served by belt conveyors, small measuring bins, and Garr charge guns.

Blister copper is transported in ladles to two 13x25-ft. anode furnaces fired by a low-pressure gas burner. The lower half of the furnace is lined with 18-in magnesite bricks, and the upper half with 13-in. brick resting on insulating bricks. Each furnace has a capacity of 175 tons. From the furnace the copper is emptied into an air-operated pouring spoon serving the 40-ft. anode casting wheel. It contains 26 copper molds for 700-lb. anodes. An electric battery truck equipped with lift forks transports cooled anodes from storage successively to scales and railroad car.

Gases from the reverberatory furnaces and converters pass through a short flue system, multiple cyclone system, and concrete stack to the atmosphere. Converter flues of the balloon type are 18 ft. in diameter and the hopper-bottomed reverberatory flues, 15 ft. Reverberatory dust is removed from the hoppers by drag-chain conveyors. The multiple cyclone system just ahead of the junction with the reverberatory flue consists of six units made up of 45 16-in. cyclones. Collected dust is transferred to a storage bin by screw conveyors. A bypass flue permits cutting out the cyclone system whenever this is desired.

Dust from the converter flues, collector, and reverberatory flues held in a common storage bin is pumped back to the bedding plant, where it is conditioned with water in a pug mill before being added to the conveyor operating between the filter plant and the bedding plant. Flue sections requiring insulation are covered with glass-wool blankets held in place by heavy wire mesh.

The concrete stack serving the smelter is 612 ft. high, with a 24-ft. inside diameter at the top and 38 ft. 10 in. at the bottom. The concrete shaft is lined with acid-resisting firebricks in acid-proof mortar, with a layer of glass-wool blanket between the concrete and the lining proper. About 150 ft. of the top exterior is painted with acid resisting paint. A testing platform is installed about 270 ft. above the top of the stack foundation. It is accessible by the steel inspection ladder extending to the top of the stack, where 12 copper points connected to grounded cables give protection against lightning. Capacity of the stack at 4,338 ft. elevation is estimated at 1,000,000 cu.ft. per minute at 500 deg. F. gas temperature and 90 deg. atmospheric temperature. At the smelter two additional reverberatory furnaces and three converters are being added.

The modern power plant near the smelter furnishes power for the mine, reduction works, and townsite. It contains three 12,500-kva. steam turbines operating at 3,600 r.p.m. and generating current at 13,200 volts, 3-phase, 60 cycles; a high-pressure air compressor, and three 27,500-c.f.m. rotary blowers furnishing air for the converters at a pressure of 15 lb. per square inch. About 60 percent of the steam required is generated by two gas-fired steam boilers of the water-walled, three-drum type, and 40 percent is furnished by the waste-heat boilers in the smelter. Each boiler installed in the power house has a continuous capacity of 160,000 lb. of steam per hour at 748 lb. per square inch pressure and 750 deg. F. total temperature at the superheater outlet. In case of failure of the gas supply, and auxiliary fuel-oil system can be cut in on short notice. Boiler operations are practically automatic, and indicating and recording instruments are installed at different points in the boiler and turbine rooms. Steam from the waste-heat boilers reaching the power house at 630 deg. F. is mixed in a manifold with steam from the direct-fired boilers, subsequently to be brought up to final temperature for direct delivery to the turbines in a direct-fired superheater. Under the projected plant expansion program, generating facilities at the power plant will be increased by addition of a 12,500-kva. turbine and extra blowers.

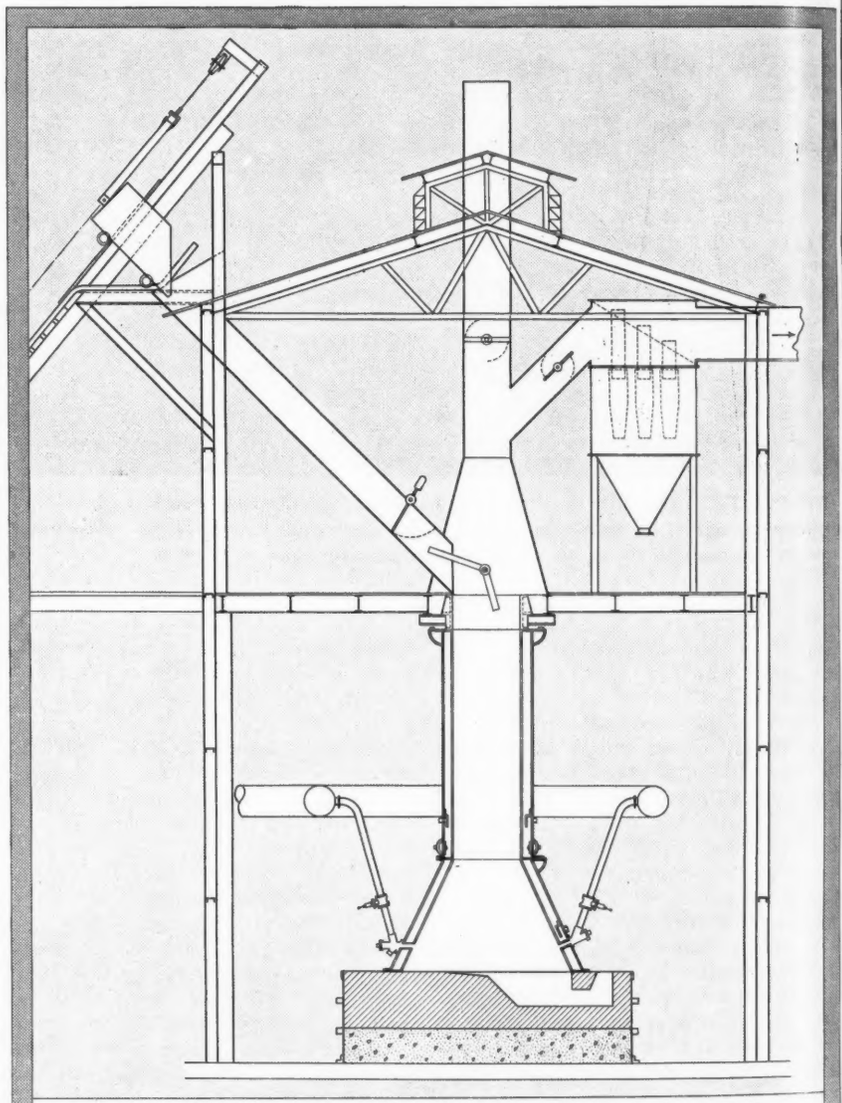
The modern shops at the reduction works are equipped with machinery of latest design and construction. Near by are a modern change house and warehouse. The model town of Stargo has grown considerably during the past year, and a new settlement is now under construction near the reduction works. At Morenci proper many of the older structures either have been modernized or replaced by new ones. No effort is spared by the company to improve living conditions and to provide recreation facilities for its workers and employees.

A BLAST FURNACE

for Solving Blast Furnace Problems

Special features of design are expected to obviate many operating difficulties now experienced

John S. Stewart
Metallurgist
New York



PROPOSED NEW TYPE BLAST FURNACE having inverted bosh which forms enlarged and intensified smelting zone confined to bottom of furnace. Shaft area is small in relation to area at tuyere plane, and most of increased number of tuyeres are downwardly inclined

THE BLAST FURNACE is one of the oldest types of metallurgical furnaces. It had its beginning centuries ago. In many parts of the world, primitive furnaces for making small amounts of copper, iron, and lead relied on the reduction of the metals by forcing a blast of air, produced by blowpipes or bellows, through a mixture of charcoal and hand-picked, high-grade ore.

In the last 40 or 50 years, the nonferrous blast furnaces have gone through many changes in shape and proportions. The earlier furnaces had short, narrow cast-iron jackets, with brick shafts extending vertically to the charge floor. The cast-iron jackets were then replaced by steel-plate ones, which were wider and had more tuyeres to each jacket. The short jackets had an abrupt bosh, starting 6 to 9 in. above the center line of the tuyeres and flaring outwardly to the top of the jacket. A furnace of a later date, but of the same general construction, had the brick shaft continuing the bosh line of the tuyere jackets at the same angle as far as the charge floor.

The steps that followed were the increasing of the height of the tuyere jackets and, later, the replacement of the brick shaft by top water jackets. Some of the latter formed a vertical shaft; others flared, but less abruptly than the angle of the bosh. A still later furnace gave an equal but more gradual slope, or bosh, of both the bottom and top jackets, extending from the hearth, past the tuyeres, to the furnace top at the charge floor.

Within this period, many common widths of furnaces, at the tuyere plane, ranged from 36 in. and even less, to over 60 in. Tuyeres ranged from 6 in. to 4 in. in diameter. The latest development is a 2½-in. tuyere, but with double the number.

The cross-section of nearly all nonferrous blast furnaces may generally be stated to have been, and is now, constricted at the tuyere zone, with an upwardly and outwardly flaring bosh, either abrupt or gradual, which creates a considerably wider furnace at the top. This shape, which imparts an increasingly expanding area to the furnace, from the tuyeres to the feed floor, causes the charge to descend in the shaft very slowly, even when the furnace is in good operating condition. Also, the velocity of the gases ascending through the charge column is progressively diminished.

The bosh of the furnace not only

offers resistance to the downward thrust of the charge overlying it, with the attending increased frictional resistance to the center core of the charge column, but the bosh also, because of its taper, has the shape of skewbacks on each side of the furnace at just the place (on one that is newly blown in) where the descending charge has reached a semi-fused state. This sticky material lodges on the skewback-shaped bosh, building farther toward the center of the furnace, forming shelf-like protrusions as time goes on. On these shelves, additional accretions form, largely from the fines of the charge column that collect on the shelves. It is not long until the accretions extend up the shaft to the top of the furnace, being particularly heavy at the ends. The descending streams of molten slag, coming in contact with the cold air blasts, form noses on the tuyeres which build up toward the shelves in the semi-plastic zone, until there is only a restricted opening in the lower portion of the furnace, of varying width throughout the length of the furnace. At some places the shelves build out until they bridge over, forming an arch from one side of the furnace to the other. The arch interferes with the descent of the overlying charge and the even and equally distributed rise of the combustion gases. A thick layer of fines settles on this portion of the charge column at the top of the furnace, and this part of the furnace goes dead and ceases to smelt. The coke under the arch soon burns out and there may be a concentration of the blast from several tuyeres that will find a convenient passageway up through the "dead spot," and a "blowhole", extending to the top of the charge, may occur.

Cause of "Hot-top"

At other portions, the shelves protruding from the bosh towards the center of the furnace leave such a restricted opening that no coke reaches the tuyere zone. Then the coke burns higher in the furnace and the smelting zone also rises higher in the furnace, forming, perhaps, new planes of semi-plastic material which can adhere to the accretions already formed. At other times, portions of a furnace may have heavy crusts and the charge column may become partly choked by fines, so that only a limited amount of blast and combustion gases will penetrate and ascend through the charge. This will cause such a slow descent of the charge, and such a long time of contact of the coke and the hot ascending gases, that a slow burning of the coke may rise higher and higher in the furnace shaft, giving a "hot-top."

Oldright and Miller, in a series of Bureau of Mines bulletins, describe in a masterful way, and in great detail, what happened in lead blast furnaces at three different smelters. The description of many of these blast-furnace troubles will touch a reminiscent chord with not a few metallurgists.

One of the most troublesome personal experiences was the operation of a lead blast furnace in Russia which was passed on from an old smelter, re-erected and ready for operation shortly after the Revolution started. It was an hexagonal furnace, 27 in. across the tuyeres and, in a rise of 27 in., the furnace expanded, by virtue of its bosh, to three and a half times its area at the tuyeres. With such a narrow furnace, abrupt funnel-like bosh and six corners, it was no time until it had arched over. It would continue to make slag, but with no subsidence of the charge for several hours; then the arch would break and the charge column drop 7 ft. at once, only to start the cycle again. The only correction that could be made was to put fillers between the jackets so as to widen the furnace. By doing this, a smelting campaign of seven to ten days could be obtained, when the charge column would be reduced to about 2 ft. in diameter by the formation of accretions around it, and the furnace was shut down to be dug out.

The effect of the width of a blast furnace and increasing the volume of air was seen back in 1920 on the smelting of malachite ore in the Belgian Congo. The smelter consisted of two blast-furnace plants for smelting the same ore. The "A" plant had furnaces originally 50 in. wide at the tuyeres, but these had spread at the bottom until actually the distance was about 55 in. There was only one tier of jackets, which were long ones, so that the furnace was 14 ft. high from the bottom to the top of the jacket. A continuous flare of the bosh gave a width of 72 in. at the top. The "B" plant had furnaces 44 in. wide at the tuyeres, with the bottom jackets having a bosh flare, in 8 ft. of vertical rise, so that the furnace was 72 in. wide. The top jackets continued vertically 7 ft. 4 in. to the charge plates. The wider furnaces continued smelting day after day, giving no trouble and requiring little attention, but the narrow ones were a constant source of worry. Heavy crusts would form on the walls of the shaft of the furnace, arches above the tuyeres were often present, the tuyeres were constantly slagging, and the black copper in the furnace crucible would freeze. Raising the amount of air furnished the remedy, and the furnaces from then on ran quite satisfactorily. The wider furnaces, on a much less volume of air per square foot of tuyere area, continued with good performance. (There was not sufficient blowing capacity to raise the air on the "A" plant.)

High Blast Volume Helps

At another plant in northwest Canada, smelting semi-pyritic charges, alternating at times with charges of sinter, proved the value of large air volume, and also showed the bad effect of ore fines. The furnaces were 54 in. at the tuyeres and 30 ft. long. By increasing the volume of air, the furnace reached a monthly average of 1,115 tons of charge per furnace day, or 8.25 tons per square foot of tuyere area. When running at the faster speed, they gave little trouble and the campaigns lasted until the settler or something else gave way. When running on a lesser blast, a campaign average of only fifteen days was the practice. Then the furnaces were shut down to dig out the crusts. The furnaces slowed down and crusts formed much faster when the percentage of the ore fines was large.

As stated, common widths across the tuyeres have ranged from under 36 in. to over 60 in. The higher figure is certainly not the limit. Archer E. Wheeler in 1911 erected a blast furnace for smelting copper ores, 7 ft. wide at the tuyeres. This furnace ran for four years, with six shutdowns to repair the old jackets from which it was made. The tuyeres remained open and "no central core of unmelted charge was observed." The furnace was about 18 ft. high above the tuyeres, but the charge column was actually about 14 ft. high. The pressure on the furnace ranged from 48 oz. to 56 oz. Better tonnages were obtained per square foot of tuyere area and the coke was lower than the usual conventional fur-

naces that were running on the same charge at the same time.

Three years ago, in the Slovenia district of Yugoslavia, the operation of a circular lead blast furnace, 6 ft. 3 in. in diameter at the tuyeres, was observed. It was practically vertical throughout—no bosh at all. The furnace was running smoothly, the lead in the slag was low, and no irregularities were common. Mr. Fettick, the manager, gave me charge tonnages representing 4.68 short tons per square foot of tuyere area while smelting gray slag from Scotch hearth furnaces. The furnace was purposely being run slowly to prolong the campaign, as it had a much greater capacity than the tonnage of gray slag currently made. With this low tonnage of a fast-smelting material like gray slag, indicating low volume of air, no central unmelted core was found on this wide furnace.

What Features Are Desirable in a Blast Furnace

Summarizing those features in a blast furnace that contribute to smooth, fast, and economical smelting, we may list the following:

1. The shape should be such that would discourage the formation of shelves, arches, and accretions.
2. The wider furnace at the tuyeres is preferred.
3. A large reserve of coke should be present at the tuyeres.
4. A large volume of air of sufficiently high pressure, distributed evenly at the tuyeres, in order to get deep penetration of the blast, a hot localized smelting zone and high CO concentration.
5. The smelting zone should be confined to the lower part of the furnace —not high in the shaft.
6. A large space for storage of slag, so that reduction will be complete and there will be sufficient time for settling of metal and matte particles.
7. A non-slagging design of tuyere.
8. High velocity of gases in the shaft to remove excess fines and give less opportunity for ascending volatile matter to condense in the furnace.
9. Rapid subsidence of the charge in the shaft.
10. A short shaft, so the charge will pass to the smelting zone before it has reached the sticky, semifused state, and the coke will be allowed to burn only in the lower part of the furnace.
11. A small area shaft to prevent segregation of the charge ingredients, thereby maintaining the mixture.

A Blast Furnace That Meets These Requirements

A type design of a furnace that would seem to meet these requirements is shown in the drawing on page 64. It is the direct opposite in many ways to the conventional type of blast furnace. Instead of having a contracted smelting zone, with a constricted tuyere diameter or width and an outwardly flaring bosh giving a large volume in the shaft and a large area at the charge floor, this furnace presents a large area at the tuyeres, an enlarged smelting zone at the bottom of the furnace, and a small area in the shaft. The slant of the lower jackets forms an inverted bosh, and, with the shaft, the shape of a circular furnace would be that of an inverted funnel. The lower jackets form a hollow truncated cone, with the vertical shaft of the small truncated cross-section diameter extending to the charge floor.

Its Advantages Over Conventional Type: The Tuyere Plane—This new type of furnace has a tuyere line which allows a much larger periphery, so that a greater number of tuyeres may be used than on an ordinary furnace. These not only will permit a larger volume of air to pass into the furnace, but will distribute the air evenly to the large reserve of coke at this plane. Further, for a given quantity of air, use of a greater number of tuyeres will give lower velocities in the tuyere pipes and less tuyere resistance. The tuyere plane will be much larger than in the conventional furnace of equal-diameter shaft and the area of CO concentration will be greater.

Smelting Chamber—The inwardly flaring jackets, forming an inverted bosh, do away with the skewback shape of the present furnace. In fact its skewbacks-in-reverse will tend to prohibit the growths that usually form on the face of the jackets at the plastic level, just above the smelting zone. Therefore, it will be impossible for shelves and arches to form; hence, no base for shaft accretions to build upon. Even any noses developing at the tuyeres, due to the cooling effect of the impinging blast on the downcoming slag, will have such a small area of base that the nose will never protrude far into the furnace.

The smelting chamber, being a hollow, truncated cone and having a small-diameter shaft superimposed upon it, forms a constricted area for the large volume of gases to pass through. This will develop a higher pressure than usual in the smelting chamber.

A larger mass of coke will accumulate in the smelting chamber and will always be present. This, with the large volume of air and the higher pressure in the furnace, gives the three conditions that promote rapid combustion. The high rate of combustion will so localize the high-temperature smelting zone that the level of incipient fusion will be lowered. The high-temperature zone, containing large volumes of coke and air at higher pressure, will insure a high concentration of CO gas in the smelting zone. All these factors together cause a high smelting rate.

The base of the cone provides a large hearth area, and with ample height between the hearth and the tuyeres, a large storage of slag will accumulate before it is necessary to tap. The longer time for settling, particularly under such strong reducing conditions, should give less metal loss in the slag and cause less fluctuation of temperature in the furnace due to tapping the slag.

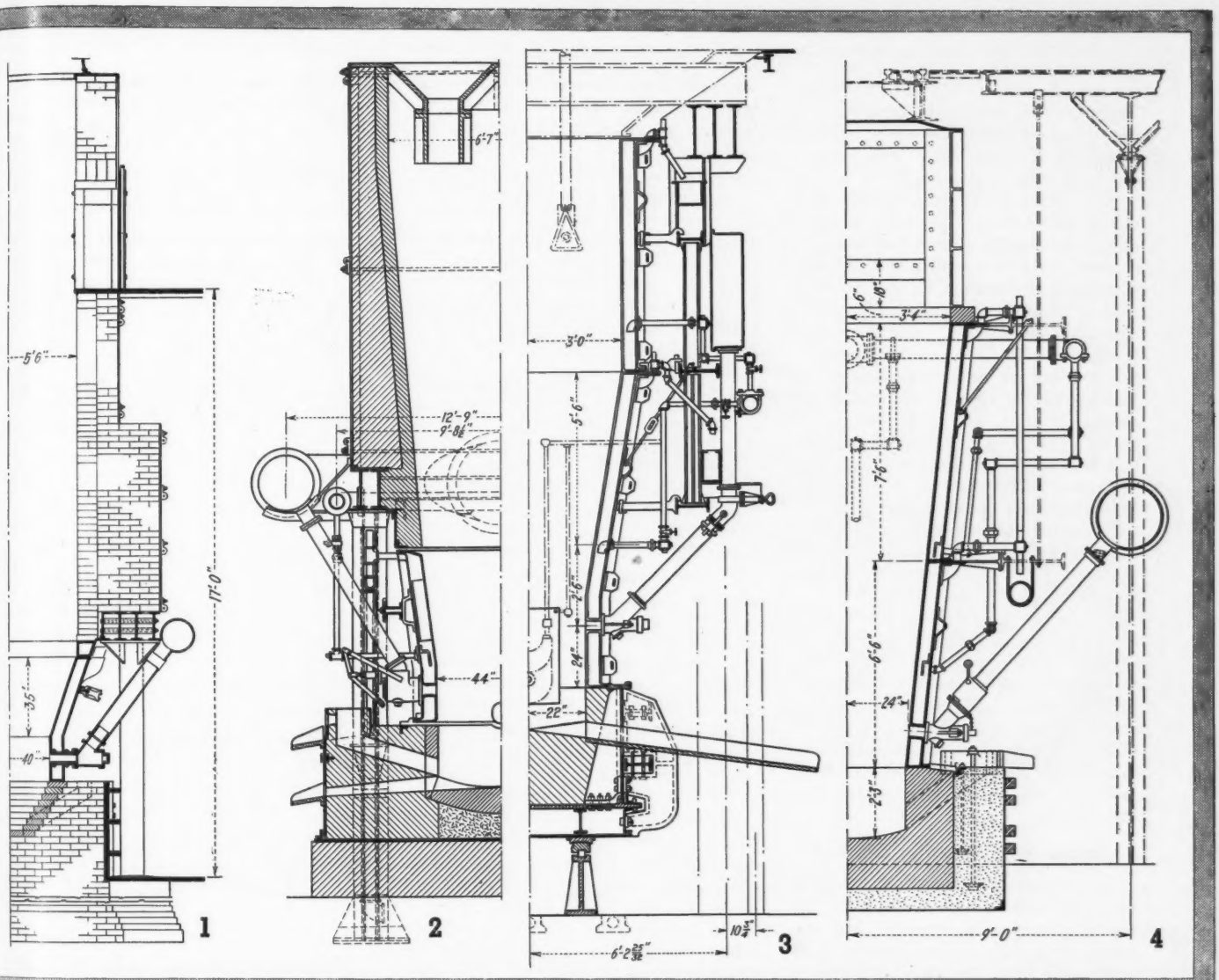
The inverted funnel-shaped smelting chamber, creating a larger proportion of charge volume to jacket surface than usual, will permit less heat dissipation by the jacket water. This, together with the fact that the coke will burn lower in the furnace and not in the shaft, will result in a lower percentage of coke on the charge.

If each descending charge in the shaft is, say, a foot and a half in height, it will when it reaches the inverted bosh, spread out in a thinner layer and result in a better mixture.

The Tuyeres—The furnace has two types of tuyeres, each 2 in. in diameter. Most of the tuyeres are at right angle to the inclined jackets, so that the tuyeres point downwardly. There are also one or more tuyeres on each jacket which are horizontal and have slag-escape holes. As both types have common center lines, the lowest point on the horizontal tuyeres will be somewhat lower than the lowest point of the inclined ones. Thus the former will act as safety tuyeres which will give warning if the slag in the furnace should rise to the tuyere level, and will prevent the inclined tuyeres from becoming fouled with the rising slag.

The inclined tuyeres and the inwardly sloping jackets will prevent the tuyeres from slagging. Any noses formed under the tuyeres will also be sloping downwardly, so that no upwardly inclined or horizontal gutters, that often form in tuyere noses and which direct slag streams into the tuyeres, can occur. Also, the slag will drip off the face of the inclined jacket, by reason of its overhanging position, and cannot flow into the tuyeres, as often happens with ordinary jackets.

The air jets from the tuyeres will project downwardly towards the bottom of the smelting chamber, and, being under relatively higher pressure, will penetrate well into the bottom center of the coke mass. As the furnace will have a large area at the plane of the tuyere centers, a large mass of coke at this point, and the slope of the jackets will discourage long tuyere noses, it seems improbable that the large volume of air introduced will blow the furnace "cold," with the resulting small smelting zone at the tuyeres and larger smelting zone well up in the shaft, which is experi-



SOME TYPES OF BLAST FURNACES USED FOR LEAD AND COPPER ORES FROM 1900 TO PRESENT

(1) Lead furnace with tuyere jackets having wide-flaring bosh and vertical brick shaft. Width at tuyeres 40 in., expanding to 5 ft. 6 in. in vertical rise of 35 in. Height of charge column from tuyeres to charge floor, 17 ft. (2) Lead furnace with tuyere jackets and brick shaft continuing bosh line of jackets at same angle until it reaches charge floor. Width at tuyeres 44 in. Width at charge floor 6 ft. 7 in. Height of charge column from tuyeres to charge floor 18 ft. 2 in. (3) Copper furnace with tuyere and vertical top jacket. Width at tuyeres 44 in., expanding to 6 ft. in 7 ft. of vertical rise. (4) Lead furnace with tuyere and top jackets with bosh line of both jackets continuing at same angle. Width at tuyeres 48 in. Width at charge floor 6 ft. 6 in. Height of charge column 18 ft.

enced with narrow furnaces. Rather, it is to be expected that with a well-proportioned furnace, having a large-volume smelting chamber whose jackets flare inwardly, with a wide area at the tuyeres and downwardly penetrating blast jets, the smelting area will be confined exclusively to the lower part of the furnace. The zone of incipient fusion which overlies the incandescent coke will also be within the truncated cone, so that the semi-plastic mass will not have skewbacks on which to form an arch, but the slope of the jackets will be the antithesis of a skewback. Therefore, no accretions will form in the smelting chamber and no ledges will be formed for further accretions to build upon in the shaft. In other words, the solid form of the ingredients of the charge will maintain their physical shape in the shaft, and will not start to pass through the semi-fused state until they have passed through the vertical shaft and entered the smelting chamber.

Shaft—The shaft of the furnace, superimposed on the truncated cone smelting chamber, has a much smaller diameter than at the tuyeres.

Inasmuch as the smelting chamber with its inverted-funnel shape has a bigger volume per unit of height than the volume of the shaft for the same height, the charge in the shaft will descend faster in a given length of time than in the ordinary furnace; thus, no opportunity is given for the smelting zone to rise in the shaft. The rapid subsidence of the charge in the shaft will not permit the coke to start burning until it has reached the lower part of the furnace, resulting in a higher thermal and reduction efficiency.

As the smelting zone will be confined to the lower part of the furnace, the height of the charge column, and hence the top jackets, may be made shorter than in the conventional furnace.

With a much greater volume of air per square foot of shaft, the blast pressure will be higher. This will result in the blowing of the fines out of the furnace by air classification. These fines may be caught in a small unit of any good dust collector such as the Western Precipitation "Multiclone"

or the American Blower "Cyclone." The dust will be ideal for adding to the sinter charge. The gases passing from the dust collector will be conducted to the baghouse.

The absence of fines, which ordinarily choke the air passages in parts of the ore-charge column and cause air channels in others, will result in faster smelting and freedom from the formation of accretions on the shaft jackets resulting from fines. Further, it is probable, with the higher velocity of the combustion gases through the interstices of the charge, and the shorter charge column, most of the volatile fumes will pass through the charge and will not crystallize on the furnace jackets—another cause of accretions. With the free passage and even distribution of the combustion gases and the fast descent of the charge in the shaft, no "blowholes," "hot-tops," or "dead-spots" will occur.

The shaft, having less diameter or area per ton of charge smelted, will permit improved and simplified methods of charging. The ingredients in the charge will not have room to segregate as it falls on top of the charge column, but will maintain the mixture as it was prepared. A simple deflecter will give even distribution over the whole area.

Improved Charging Method

No expensive charge cars will be required for this type of furnace. The charge may be delivered by belt conveyor, or a skip, to an inclosed chute, preferably long enough to hold one or more charges, and of small cross-sectional area so that the charge will be confined and not allowed to segregate. A swinging gate at the end of the chute, where it enters the furnace hood, will allow small quantities of the charge to be fed to the furnace at a time, instead of dumping the complete charge, should such a method be desired. Charging this way maintains a constant height of column.

In the conventional furnace, a large volume of air is sucked through the open charge doors. With this new-type furnace, the smaller area of shaft permits the design of a small furnace top-hood, which will not only give a smoke-free atmosphere on the charge floor, but a hood that will be nearly tight, so there will be small dilution of the gases by infiltrated air. The result will be a smaller dust collector and baghouse fan, and less bag area.

The small top-hood may be designed in such a manner that it can be easily moved from the top of the furnace, giving access to the shaft and the top jackets during periods of repair.

Other Advantages—The conical shape of the smelting chamber and the smaller diameter of shaft will give a stronger and less expensive construction for a furnace of a given tonnage. Also, the cost of the building, hoisting, and auxiliary equipment and baghouse will be considerably less than that for the present blast furnace.

A furnace of this shape, with the tuyeres pointing downwardly, would seem to be of the proper construction for blowing pulverized coal, or even other fuels, into the tuyere zone. In fact, the primary combustion could be made to take place before the fuel entered the furnace if desired.

Proportioning the Furnace

The angle of slope of the jackets should be greater than the angle of repose of the charge within the furnace; otherwise there would be a space between the charge and the jackets. However, the angle of slope should be small enough so that the periphery at the tuyere plane will permit a large number of tuyeres. On the other hand, the angle of the jackets should be great enough to have ample height between the tuyere plane and the base of the shaft, so as to have the smelting zone and the level of incipient fusion confined within the conical smelting chamber and not rise into the shaft, while at the same time having the width at the tuyeres not excessive.

The distance from tuyeres to hearth should be such as to allow an upward turn of the downwardly impinging blast jets, and also for an ample accumulation of slag between taps, so as to permit good reduction and settling, and to control temperature variations due to tapping.

The drawing on page 64 represents one design of a furnace having a 3-ft.-diameter shaft, with four bottom jackets forming the hollow truncated cone. The breast jacket will be inserted in cut-outs in the two front jackets. With this arrangement, ten 2-in. tuyeres could be located in each of the back jackets and eight tuyeres in each of the front jackets, making 36 tuyeres in all, should it be desired. The usual furnace with a 3-ft. shaft has from six to nine tuyeres. With the large number of tuyeres, good distribution of the blast should result.

The shaft diameter should of course match the diameter of the truncated cone of the smelting chamber. It should be large enough so that the interlocking pieces of charge will not wedge in the shaft, but still be of relatively small diameter compared with the diameter of the tuyere plane.

The height of the shaft should be such that the weight of the column of the ore charge is in excess of the total gas pressure over the cross-sectional area of the shaft. Also, of a height that the descending charge will accumulate heat from the ascending gases, but will not reach the state of plasticity until it has passed through the shaft and entered the smelting chamber. Another factor in determining the height of charge column is the pressure desired in the smelting chamber. The interstices of the charge in the shaft may be thought of as a series of small pipes through which the combustion gases flow. But these "pipes" have many elbows and bends, and their walls are rough and ragged, so the frictional constant is high. Each additional foot to the charge column will measurably increase the pressure, but as the smelting zone is low in this furnace, the effective height of charge column above the fusion zone will be greater than in one in which the smelting zone is well up in the shaft.

THE STEWART blast furnace, in the author's belief, holds promise of superior smelting of sinter, gray slags, drosses, refinery byproducts, mattes, and ores, as done in lead and copper smelters. Also, because of the intensified-smelting zone and large hearth volume provided, the furnace should be valuable in smelting highly refractory ores, in fuming zinc from lead furnace slags, and as a foundry cupola.

—EDITOR

Furnaces of larger capacity, but still having a small width of shaft in relation to the width at the tuyere plane, can be built by inserting one or more straight jackets between the curved halves of the furnace. Also, a furnace of the same cross-sectional shape, but with straight or flat end-jackets, may be constructed, although the curved jackets are preferred, as they give the opportunity to place more tuyeres in the ends.

Further, in a furnace that is required to smelt a charge that has the tendency to swell as it descends in the shaft, of which iron blast-furnace metallurgists speak, the shaft could also have a slight taper from the top of the truncated cone to the top of the furnace. But it is believed that this would be necessary only on a furnace with a high shaft and smelting a charge where the major part of the reduction is to be carried out in the shaft above the smelting zone.

The type of blast furnace which has been described has never been operated, so the description of its performance is purely speculative. It is a wide departure from the present-day furnace, but it would seem to overcome many of the difficulties experienced in blast-furnace smelting.

ULTIMATE EXPRESSION of Yuba's long experience in dredge designing. Yuba No. 20 can dig to a maximum depth of 124 ft. and carry a 50-ft. bank ahead when necessary. With 18-cu.ft. buckets, the dredge handles 90,000 cu.yd. weekly

Deep Gravels Dredged Successfully

Carefully designed for digging at great depths, Yuba No. 20 sets performance records

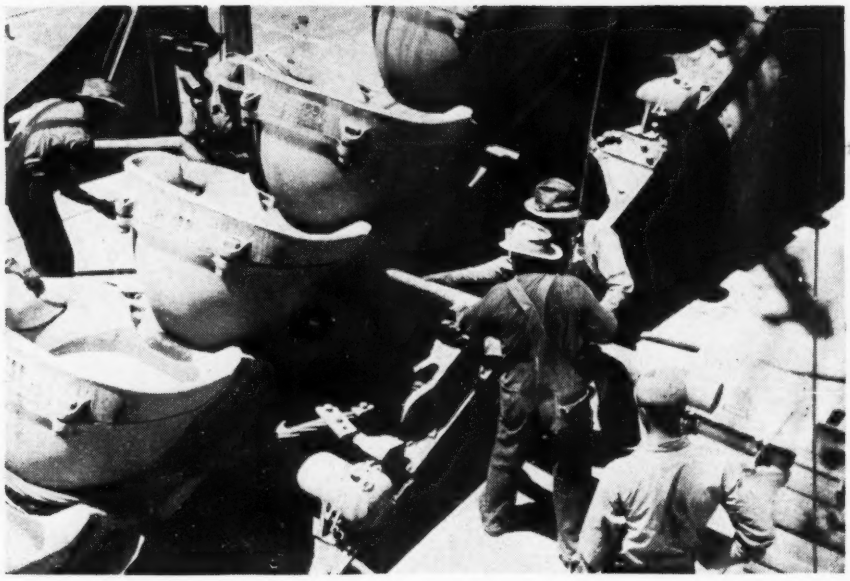
Herbert Sawin, *Sales Engineer, Yuba Manufacturing Co., San Francisco, Calif.*

MODERN DREDGES, as operated by Yuba Consolidated Gold Fields, overcome obstacles today that seemed insurmountable only a few years ago. Early California dredge men considered a digging depth of 60 ft. below water level the maximum range of economical bucket-line dredging. Later, owing to new designs and improved materials, 80 ft., then 112 ft., and now 124 ft., below water level are profitable operating ranges. Based on experience with Yuba 17, a 3,500-ton gold dredge built in 1934 and operated at Hammonton, Calif., which dredged abrasive and tightly packed gravel at depths to 112 ft. below water level, Yuba 20 was designed and built for the same field, starting operations on May 1, 1939. This newest addition to a fleet of six 18-cu.ft. dredges digs to a depth of 124 ft. below water level, at times against a bank of 50 ft. The contract for Yuba 20 was signed Aug. 4, 1938. The first hull plates were laid in November, and the hull was launched 30 days later. The job was completed, and the dredge operated its first full day, on May 1, 1939. Considering the weight of 3,700 tons, the period of less than eleven months from contract date to starting of the dredge is noteworthy.

Electrically operated and displacing about 3,700 tons, the steel hull, superstructure, and gantries of the dredge alone weigh 1,500 tons. The digging units weigh 860 tons exclusive of gravel and suspension parts. Its steadiness in the water while digging is noticeable at once to a visitor acquainted with placer mining dredges. The hull measures 250 ft., 8 in. by 80 ft. by 11 ft. The digging ladder is 216 ft. long and 13 ft. ¾ in. deep; the main stacker measures 225 ft. between pulley centers, and carries a 44-in. rubber conveyor belt. With the ladder raised to 30 ft. above water, over-all length of the dredge is about 540 ft. These weights and dimensions clearly indicate the huge size of the dredge. Perhaps it is easier to visualize a dredge as long as an average city block and with its topmost point, the stern gantry, ten stories above the pond surface.

Describing the dredge briefly from "stem to stern," principal parts include the following:

1. Manganese-steel, two-piece lower tumbler with nickel-steel shaft.
2. 135 manganese-steel, rivetless-lip buckets.
3. Forged nickel-chromium steel bucket pins.
4. One-piece cast high-carbon-chro-



COORDINATED EFFORT is required of the men here shown changing pins in the 18-cu.ft. buckets of Yuba No. 20. Dual main drive motors aid winchman in adjusting bucket line to align openings for pins

mium steel upper tumbler having shaft cast integral.

5. Forged nickel-chromium steel tumbler wearing plates.

6. Perry bucket idler mounted on under side of digging ladder.

7. Bucket idler in well.

8. Packed lower ladder suspension blocks.

9. Cast-steel upper and lower block sheaves, 60 in. diameter.

10. Ladder hoist lines, 2-in. wire rope.

11. Monitor on bow to knock down high banks.

12. Revolving screen 50 ft. 6 in. long and 9 ft. diameter, using ¾-in. Yuba ARS screen plates, and with friction drive at lower end.

13. Winch room on the center line of the dredge with flying bridge extending to both sides.

14. Two-drum ladder hoist winch on port side.

15. Eight-drum swing winch on starboard side, having separate drums for each of the port and starboard bow lines.

16. Auxiliary stacker 48 ft. long with 44-in. belt to carry oversize material from the screen to main stacker or to rock chutes.

17. Main stacker about 18 deg. for normal work, but this can be changed as desired.

18. Double-drum stacker hoist winch driven by a single motor with worm drives.

19. Two spuds, box type, 37 in. x 60 in. by 70 ft.

20. Table area, 6,000 sq. ft., single-bank, double-decked with molded rubber Hungarian-type riffles.

21. Hinged top deck sluices can be raised to clean up lower sluices.

22. Tail sluices extending about 30 ft. aft of stern.

23. Auxiliary spill chute aft of screen, permitting rock tailings to be discharged through a well in the stern.

24. Two sand wheels discharging to 30-in. belt conveyors which carry excess sand to the main stacker.

25. Conveyor idlers, troughing and return, of the anti-friction type.

Pumps include the following Yuba centrifugal units: One 14-in., 70-ft. head, 5,500 g.p.m.; one 14-in., 52-ft. head, 5,500 g.p.m.; one 6-in. dual, 116-ft. head, 1,100 g.p.m.; one 4-in. auxiliary, 65-ft. head, 450 g.p.m.; and a 2-in. service pump. A Yuba mud removal system using an 8-in. Byron-Jackson pump rated at 3,000 g.p.m., 245-ft. head, also furnishes water to the monitor mentioned previously. Total installed load is 2,175 hp., all a.c. power.

Two variable-speed drive motors, each 300 hp., 600 r.p.m., are situated just aft of the upper tumbler, one on each side, with V-belts connecting them to the pulley shaft. This arrangement was first tried on Capital No. 4 dredge, built in 1937, where the multiple a.c. motor drive has been entirely satisfactory and resulting in a simple, trouble-free installation. The ladder winch is separate from the main drive, thus eliminating the large belt formerly needed. V-belt drives are also used on the swing winch, screen drive, and main and auxiliary stackers.

The main drive on Yuba 20 has proved to be highly successful. At Hammonton, about 90 ft. below water level, there is a particularly hard (but not cemented) gravel stratum. The drive in question helps materially in solving dredging problems associated with digging hard formations at great depths. The double V-belt main drive provides a flexible unit which acts as a safety link capable of absorbing severe shocks and protecting the rest of the digging unit in the event of sudden or severe overload. Bucket line speed is 21 per min., based on the experience of several deep digging dredges in California.

In general, dredges digging 100 ft. or more below water level have been found to excavate less material per day than units of the same bucket capacity digging at 80 ft. or less. For example, Capital No. 4 dredge, digging to 82 ft. with 18-cu.ft. buckets, was capable of turning out 127,000 cu.yd. of gravel per week, but its most economical rate was set at 100,000 cu.yd. For Yuba No. 20, on the other hand, the greatest weekly yardage has been about 90,000 cu.yd. Reasons for this are the longer time required on the larger dredge for unproductive operations such as raising the ladder, oiling up, stepping, and moving, and the less sensitive control the winchman on the larger dredge has over the actual digging. Because of the greater weight of the dredge, he is not conscious of slight variations in digging depth as he would be on a smaller dredge, and if the buckets are not cutting deeply, several minutes will elapse before the half-empty buckets travel up into sight and the winchman drops the ladder to a correct digging position. With the larger dredge digging is necessarily slower in corners or at other points where caving might cause serious accidents. A further factor in the yardage dug by Yuba No. 20 is the tight formation mentioned in the foregoing.

Successful deep dredging owes much to the use of an idler to control the catenary of the bucket line in its return to the lower tumbler. A Perry patented idler, named for its inventor, O. B. Perry, was first used on Yuba 17 at Hammonton, Calif. Yuba 20 is also equipped with one. It is a cylindrical device, wheel-like in design, mounted on the underside of the digging ladder about midway between the tumblers. The buckets ride upside down over the idler, the contour of the face fitting the bucket lips. Renewable cast manganese-steel wearing plates are provided on the idler itself, and renewable forged nickel-chromium steel wearing bars protect the steel suspension unit. Both wearing plates and bars show little wear after many months of use, and because the long bucket line is better balanced, wear on bucket pins, bushings, and tumbler plates is reduced noticeably. The Perry idlers on Yubas 17 and 20 make it possible to use buckets and bucket pins of the same design and metal sections as on shallower digging dredges in the same field, and buckets and pins are there-

fore interchangeable on all dredges in use in this field.

The Yuba mud removal system, also a help in deep dredging, provides suction behind the lower tumbler in the form of a pipe line inside the digging ladder with a flexible hose coupling to a pump on deck. On Yuba 20, a "Y" arrangement of gate valves permits discharge of mud pumped from the pond bottom either through a pipe line carried by the main stacker to a point far beyond the face of the rock tailings, or by a floating pipe line away from the dredge to a point several thousand feet distant, where the mud can be used for filling old holes or basins. In these basins muddy water can settle and be filtered through tailing piles to avoid stream discoloration. The mud sometimes reaches a depth of 30 ft. on the bottom of the pond, crowding the lower tumbler and unless removed prevents free swinging of the dredge.

Auxiliary stacking and other stern-end equipment also attract favorable attention of experienced dredge operators. A well is provided on the center line of the hull at the stern, through which rock tailings can be discharged to make anchorage for the spuds, a departure made desirable by the length of the dredge. This is believed to be the first dredge so built. Part of the sand tailings are discharged to the main stacker belt to aid in binding rock tailings. The stacker was first used at an eleavtion of 23 deg., the high elevation being necessary during early operations until the pond became deep enough to dispose of rock tailings without such high stacking.

Deep dredging methods must be developed to suit conditions that are decidedly different from those encountered in shallow dredging. An important change is in the design of the ladder hoist winch. On Yuba 20, this unit is separated from the main drive and occupies a deck space measuring 29x14 ft. on the port side of the deck just inside the house. The total weight of the winch, including structural steel base, brake assembly, etc., is about 63 tons. The two ladder hoist lines are 2-in. wire rope on separate drums. Length of each is 2,300 ft. Each drum weighs 12 tons, and is driven through a pinion shaft which also carries the mechanical brake wheel. All shafts used on the winch assembly are nickel steel.

Power is supplied by a 500-hp., 1,160-r.p.m. type "CW" Westinghouse motor equipped with a Westinghouse Thrustor brake type HI-198, and operating through a Farrel speed reducer with a ratio of 7.181:1. All pinions and gears have herringbone cut teeth. The mechanical brake is of the post type, actuated by releasing pressure in a 10x10-in. Westinghouse air cylinder, counterweighted. Brakes are electrically operated and manually controlled from the pilot house. Manual control gives the winchman a finer "feel" and saves possible damage to equipment which might occur with full automatic brakes. The braking action, through the brake wheel to the drive pinions, slows down and stops both drums simultaneously. Immediately following the mechanical brake action, the Thrustor brake on the motor is applied automatically. A Lilly control is provided as a safety measure. Should the ladder be raised or lowered beyond safe limits or accidentally be dropped too fast, this unit would take control out of the winchman's hands and apply the brakes automatically. This type of control assures a longer life for winch parts. Internal expanding type clutches are used and are operated pneumatically from the pilot house. With drums revolving at a speed of 7.46 r.p.m., the raising and lowering speed for the digging ladder is about 12 vertical feet per minute at the lower tumbler.

The swing winch on Yuba 20 is on the starboard side just inside the front end of the house. The bow-line drums can be operated independently of the other drums on the winch, and a separate drum is used for each of the bow starboard swing lines. Other drums on the winch include two stern-line drums, two spud-line drums, and two spares. Clutches on all the drums are of internal expanding type controlled electrically through pneumatic cylinders mounted on the winch frame. The application of air cylinders to dredge equipment was originally developed and patented by Yuba about ten years ago for use on dredges to be operated in the tropics. Manually operated brakes are provided for the same reason as used on the ladder hoist winch. The winchman has better control in applying them, thus avoiding shocks to lines and thereby increasing the life of the wire rope.

The history of dredge mining proves that successful dredges are especially designed to suit conditions to be overcome in a particular field. There is practically no so-called "standard dredge." This applies in particular to deep-digging dredges, which present problems entirely different from those connected with shallow dredging. Smaller yardage with a given size of bucket naturally reduces the gross income.

The initial high cost of a dredge like Yuba 20 burdens the cost of operation, and properties sufficiently large to carry the load of such an investment are not found often. Mechanically, the limit in size for mining dredges has not been reached. Economic problems which affect the cost of dredging are the main factors limiting mechanical size at present.

An 18-cu.ft. dredge in California digging 80 ft. below water level operates at a field cost of less than 3c. per cubic yard. Beyond 80-ft. digging depth, the operating cost rises sharply, and for dredges digging 100 to 120 ft., the field cost is nearer to 5c. per cubic yard. This rising cost must be given serious thought when considering a deep dredging venture, one reason being that areas large enough and deep enough to warrant the investment, properly would not have a high average value per yard. For profitable deep dredging, the maximum dredging depth would be determined by an anticipated return commensurate with the extra operating costs. It is probable that mechanical improvements and changes will be developed which may result in dredges of larger daily capacities with a given size of bucket, and do so economically, making otherwise worthless ground valuable mining property.

Operating data on Yuba 20 have been furnished by Yuba Consolidated Gold Fields, and with thanks to that company the following information is made available: Daily operating time (three shifts) has averaged 21 hr. and 29 min. This makes full allowance for shutdowns for all reasons, including moving, ladder inspections, clean-up, repairs, and greasing. Gravel dug has averaged 12,260 cu.yd. per day at a field cost of 4.32c. per cubic yard. The weekly power consumption has been about 145,000 kw.-hr.

Michigan Tech to Prospect Upper Peninsula

IN COOPERATION WITH the Geological Survey division of the Department of Conservation at Lansing, the Michigan College of Mining and Technology is launching an intensive investigation of minerals in the State's upper peninsula, President Grover C. Dillman announced recently. A survey of iron-ore resources in the Iron River-Crystal Falls area has already begun.

Prof. A. J. Snelgrove, head of the Michigan Tech department of geological engineering, with his colleagues, Profs. W. A. Seaman and V. L. Ayres, will prospect the borders of the granite masses of Marquette and Baraga counties, including the Huron Mountain area, for commercial concentrations of tungsten, molybdenum, beryllium, and other strategic metals.

Prof. Bart Park, of the department of chemical engineering, will do the required analytical work, and Dr. A. Smith, state geologist, and Franklin G. Pardee, mine appraiser, will consult with the geologists in the field.

Are they necessary for future security?
Should they include military inventories?
Can their use as a club be forestalled?
Should domestic producers enjoy preference?

WHY STOCKPILES—?

Can they prevent postwar unemployment?
How large should they be?

To broaden the reader's viewpoint of a "hot" issue this impartial discussion is presented.

Evan Just
Assistant Editor

THE IDEA OF STOCKPILING strategic materials against a future national emergency first gained prominence shortly after the first World War. Then, a number of members of the mining industry, mindful of embarrassments which had occurred during the war, sought to foster legislation providing for strategic mineral stockpiles. The effort was fruitless, as the entire drift of public sentiment was away from war and any steps connected with military preparedness. It was only in the late thirties, when the activities of the Axis nations made it impossible to assume that war belonged entirely to history, that Congress finally enacted legislation providing for modern accumulations of strategic materials. Even then, the legislation aroused only casual interest in the mining industry and was actively opposed by the Army and Navy until they were assured that the necessary funds would be found outside their own appropriations.

Stockpile Value Proven

This purchase program was not complete when the United States became involved in the present war. Nevertheless, such inventories as had been accumulated proved to be invaluable. In the case of tin, for example, when the Japs overwhelmed Malaya and the Dutch East Indies, the stocks of tin and tin concentrates which had been built up eased what would otherwise have been a serious problem, enabling a continued supply until Bolivian production could be expanded, the new tin smelter in Texas placed in operation, and economies worked out which made the supply of tin go much farther.

Issue Revived This Year

The issue of stockpiling was revived in mid-February of 1943, when, at the annual meeting of the American Institute of Mining and Metallurgical Engineers, W. Y. Elliott, W. O. Hotchkiss, R. C. Allen, and C. K. Leith presented a symposium discussing the problem and urging action on the part of the industry to obtain legislation before the country should relapse into the anticipated postwar reaction against war and opposed to preparedness for it.

Shortly afterward, Senator Scrugham, of Nevada, who has long been a proponent of stockpiling and was one of those chiefly responsible for the legislation passed in the thirties, became actively concerned with the issue. As chairman of a mines and mining subcommittee of the Senate Committee on Small Business, Senator Scrugham had made several tours of the West, hearing compaints over government policies in regard to mining. He and the other subcommittee member, Senator C. Douglass Buck, of Delaware, also held hearings in Washington covering both the problems of stimulating small-mine production and of stockpiling. As a result of these deliberations a "Minerals Stockpile Act" was submitted by Senator Scrugham on May 3 as S. 1160. This bill was referred to the Senate Committee on Mines and Mining, which opened hearings on the bill June 24.

In mid-June a bill identical with the Scrugham bill was introduced in the House of Representatives by Congressman Murdock, of Arizona as H.R. 2895. This was referred to the House Committee on Banking and Currency, where it still reposed in early July.

The Scrugham Bill

The Scrugham bill refers exclusively to "strategic" and "critical" minerals. It contemplates the freezing of all stocks of these minerals held by the government at the end of the war, excepting those held by the Army and Navy, the same to be held for a future national emergency as determined by the President. There is no provision for handling the metal inventories represented in junked war materiel, battlefield scrap, or reserve metal supplies held by the fighting services. The bill would set up an administrative committee composed of an outstanding member of the mining industry, selected by the President and subject to Senate confirmation, as chairman, the secretaries of War, Navy, and Interior, and the chairman of the War Production Board (or the successor to his functions in regard to strategic and critical minerals). The committee would determine what minerals are to be considered strategic and critical, and what amounts are to be stockpiled to satisfy the needs for a future total war of three years' duration. Funds for the purchases would be supplied by the RFC.

For the first year after the war, the bill directs that mineral purchases shall be made at wartime prices and exclusively from small and marginal operations which shall have been in operation prior to the effective date of the act, and which have government loans or contracts or have been brought into being for war purposes. After this time, the bill directs that purchases shall be made from domestic sources to the extent that they are able to supply requirements and at prices that will insure domestic pro-

ducers a reasonable profit over their costs. Only in case and to the extent that domestic sources cannot supply needs, the committee is authorized to purchase materials of foreign origin. After the first year, purchases are to be prorated equitably among those domestic producers whose operations are certified "by the United States Bureau of Mines to be desirable in the public interest and beneficial to the national economy." The bill also contemplates the establishment and operation, under the technical supervision and advice of the Bureau of Mines, of such treatment or reduction plants as are considered desirable to carry out the purposes of the act.

Purpose of Stockpiling

The primary purpose of stockpiling, from a national viewpoint, is to prevent embarrassment of a future national defense effort by lack of the mineral materials which have proved a decisive element in modern war.

Up to the present there has been no basis for gaging what the public or average Congressional reaction to stockpiling may be. Comment up to this time has been almost entirely within the mining industry and has been generally favorable to the basic idea, although differing as to details.

The Economic Aspect

The general viewpoint within the mining industry is that something must be done to prevent demoralization of the industry by dumping into the market the tremendous inventories of minerals, metals, war materiel, and battlefield scrap which will be on hand at the end of the war. This would seem to be a reasonable expectation, as these inventories are so large that their injudicious handling can cause an industrial debacle of much deeper significance than the simple selfish interests of those engaged in mining. This is particularly true in view of the extent to which the industry has been "living on its fat," depression and burdensome taxation having prevented the industry from finding new reserves to replace those which have been in process of removal for years.

There can be no doubt that the enthusiasm of many within the industry for stockpiles is tempered by fear of large inventories being held by the government for any purpose, and thus overhanging the mineral markets with the constant threat that a change of policy might bring these stocks into the markets. Considering that the government did actually facilitate the dumping of wholesale quantities of scrap into the markets after the first World War, and that the mining industry possesses no such large, well-organized voting blocs as those which insure the deep sympathy of Congress for farmers, veterans, and Labor, these fears are not wholly unrealistic.

Amortization and Employment

One of the most troublesome problems connected with inducing people to engage in the production of needed mineral products from deposits or plants which can hardly be expected to survive postwar competition, has been that of assuring the amortization of the necessary investments. By assuring a certain continuity of existence for new operations, the Scrugham bill seeks to aid in solving this problem.

In addition to the need for "bailing out" capital and management, the government is certainly going to take heavily into account the case of workers who have become engaged in activity having a dubious postwar future. Obviously, all those employed in war industry cannot be turned away simultaneously and added to those released from the armed forces without creating an intolerable situation. War industry employment—or relief—must be carried on until industry can be reorganized for peacetime production, and a gradual transition accomplished. Thus, it seems inevitable that considerable stocks of mineral materials will accumulate after the war in addition to the inventories that will exist at the war's end. One of the economic results of a stockpiling program will be to hold at least part of these mineral supplies off the market and give the industry a chance to carry on, liquidating those elements which must go, in orderly fashion, with a minimum of demoralization and unemployment.

Considering the employment side of the question only, the argument has been expressed that, based on experience, a postwar industrial boom of fair magnitude is likely to develop shortly after the war, which after a few years' duration will probably be succeeded by a depression. On this assumption it is argued that it would be best to taper off the marginal mineral production within three years after the war, while there will be other jobs to be found, rather than to carry surplus mineral industry employment five or more years, then dump those men into the trough of depression.

What Minerals to Stockpile

The prosecution of war has become increasingly a matter of industrial power, and military objectives have tended more and more toward destroying the enemy's industrial strength. Thus, in considering the mineral needs for any future war, the terms "strategic" and "critical" are bound to take in all the minerals necessary to industry, with the exception of those so abundant and readily available that no embarrassment of supply seems possible. Certainly the terms will take in all the minerals heretofore designated as strategic or critical which do not become industrially obsolete, plus the common non-ferrous metals, copper, zinc, and lead. Considering that wartime demands for iron and steel are now roughly double those of peacetime, it seems possible that even iron and steel may be classed as critical, at least to the extent of providing an interim supply until suitable capacity can be built up.

Amounts to Stockpile

Broadly speaking, ideas on the amounts of materials to stockpile fall into three categories. The most modest idea would be simply to stockpile those excess inventories, including scrap, which otherwise would depress the mining industry's markets. In some cases even this practice would accumulate more than a year's, possibly three or four years', ordinary peacetime consumption. The intermediate viewpoint would accumulate such stocks as would be necessary to forestall shortages until adequate production facilities can be developed or built. To estimate the proper supplies for this purpose would be an intricate task, as it would not only take into account the rate at which mineral and metal capacity could be stepped up, but also the rate at which fabricating facilities could be increased and personnel trained. In the current emergency, with but few exceptions the mineral industry has been able to increase its output as rapidly as war industries have been brought into being to utilize expanded output.

The more extreme view would establish stockpiles sufficient to meet the entire needs of a future total war, not only to avoid transitional embarrassments but to relieve the manpower shortages that any future full-scale war is bound to entail. By providing for the needs of three years of total war, the Scrugham bill is an approach to this viewpoint. An analysis of the amounts it might call for is of interest.

The minimum estimates for any future war are bound to be as great as the present rates of consumption, which vary up to ten times the prewar rates of production, excepting the most extreme cases such as magnesium, whose prewar tonnages were trifling in comparison to the present output. Considering the change in magnitude of mineral needs since the first World War, it would be entirely reasonable for the committee making the determinations to set six times the present annual rate of consumption as fulfilling the requirements of the Scrugham bill. Presumably it would not be considered safe to stretch the period of

(*Continued on page* 124)

The Growth of an Independent Iron Ore Operator

With sixteen mines and facilities for ore beneficiation, including its huge sintering plant, the Evergreen company has exhibited rapid expansion

ARGONNE PIT, on the Mesabi. Inset, Hugh H. Harrison, Evergreen's superintendent for Western Mesabi, left; and Hugh Leach, district superintendent for Cuyuna Range

OPERATORS in the Lake Superior Iron Country fall into two categories, according as they have their own furnaces for making iron or do not have such facilities, in which case they needs must sell their ore in the open market. Those in the latter circumstance enjoy the name of "independent." One of these companies, the Evergreen Mines Co., though not the largest of this group, has grown interestingly since the end of 1932, when it was organized as successor to the nine-year-old Evergreen Mining Co., which had suffered from the drop in ore prices in the 'twenties.

The scene of the present company's activities is in Minnesota, on the Cuyuna and Mesabi ranges. On the former range, in addition to certain mines, it has what it avers is the world's largest sintering plant. On the Mesabi it conducts several open-pit mining and ore-beneficiating operations, which serve to supply ore for sintering and for sale. In addition, it has recently opened a mine in the southern part of the State. Until last fall it also worked an underground mine on the Vermilion Range, north of the Mesabi, until, finding the merchantable ore exhausted, it dropped the lease.

Perry G. Harrison, who also headed the earlier company, is president and general manager of Evergreen, which is a close corporation. D. R. McLennan is chairman of the board. In his organization Mr. Harrison has executives of excellent experience. Horace J. Allen, formerly blast-furnace superintendent for Bourne Fuller, of Cleveland, and then for Mystic Iron Works, of Boston, has been with the company for the last ten years and is vice president in charge of traffic and sales.

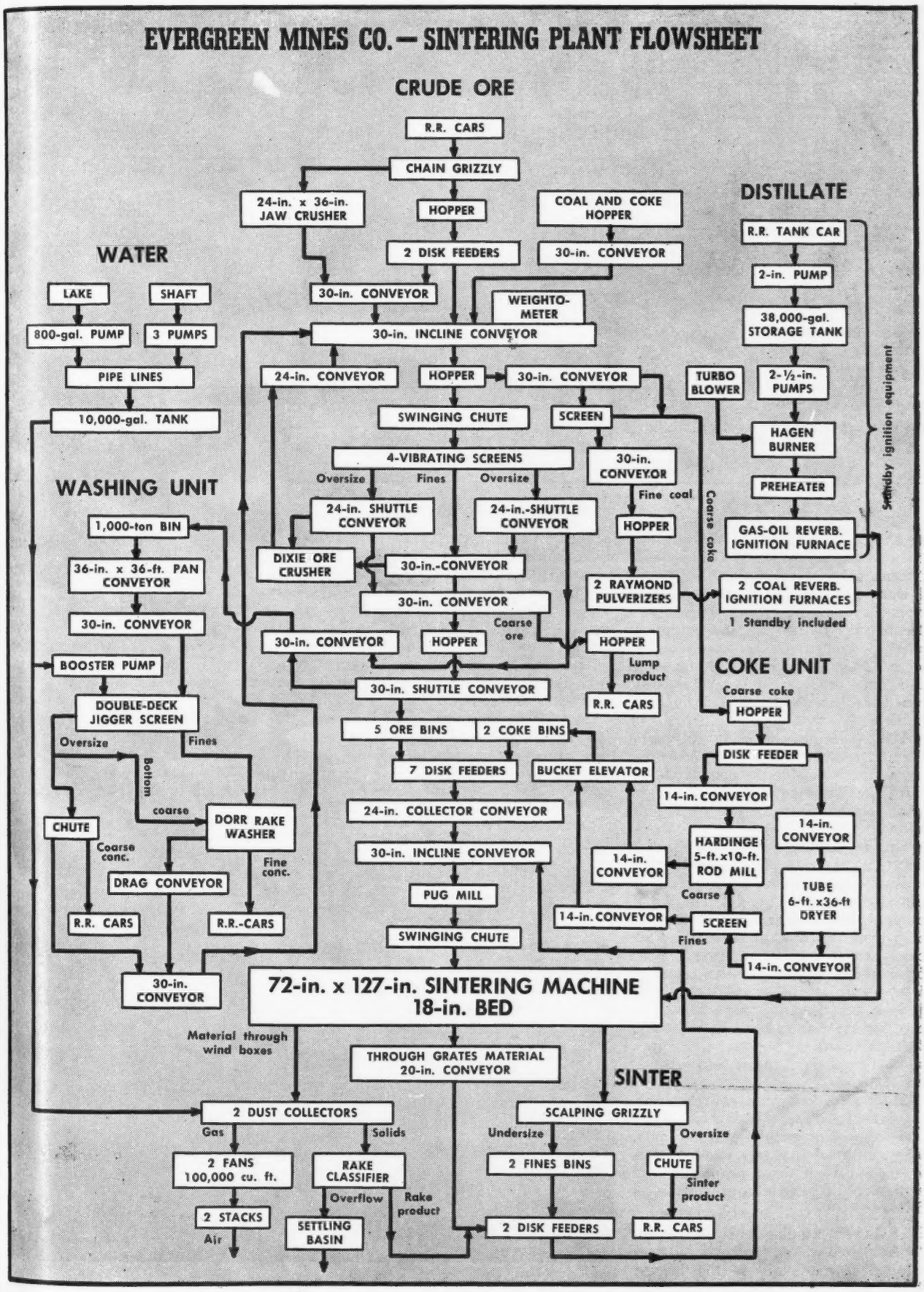
Since its organization, in 1932, up to the end of the 1943 season, Evergreen Mines Co. will have shipped from its own mines a grand total of over 11,000,000 tons of ore. Over 70 percent of this will have been turned out during the 1941-1943 seasons. Distribution of this tonnage up to the close of 1943 by ranges, by mines, and by years is shown in the accompanying tabulation. In addition, approximately 2,400,000 tons of ore has been shipped since 1935 from other sources than the company's mines.

Expressed in other words, Evergreen produces approximately 2 percent of the iron mined in the Lake Superior district and 35 percent of the manganiferous iron ore. In the last two seasons it sold all standard grades of Lake Superior ores. With the shutdown of the Chandler it ceased to produce open-hearth lump ore.

As may be noted in the table, 16 mines operated by the company contributed to last season's shipments. All

PERRY G. HARRISON, president of Evergreen Mines Co.

save the Chandler were open pits. The mines on the Cuyuna Range are at Crosby, Ironton, and Trommald. The Wearne and Portsmouth are operated by Evergreen for M. A. Hanna Co. On the Mesabi the properties are scattered, in approximately the order given in the table, from Grand Rapids, where the Greenway mine is situated, at the



EQUIPPED for four purposes, as described in the text, the Evergreen sintering plant has a flexibility discernible in this flowsheet

Evergreen Mines Co. Shipments by Mines, 1936 to 1942, inclusive

Mines	1936	1937	1938	1939	1940	1941	1942	Total
Cuyuna Range								
Evergreen	126,330	121,555	24,328	171,965	123,237	175,888	272,598	1,015,901
Wearne-Portsmouth	226,020	225,420	80,922	269,420	278,860	356,329	448,148	1,885,119
Alstead	253,723	241,998	42,400	145,647	171,437	237,358	142,000	1,234,563
Huntington	.....	.....	.....	.....	.....	59,292	91,000	150,292
Pennington	.....	.....	.....	.....	8,891	122,091	158,902	289,884
So. Hillcrest-Feigh, not operating since 1937	.....	86,064	.....	.....	.....	.....	.....	86,064
Hopkins	.....	.....	5,120	.....	.....	.....	43,000	48,120
Maroco	.....	.....	.....	.....	6,011	3,922	104,154	114,087
Misc.	.....	.....	726	.....	.....	.....	.....	726
Total Cuyuna	606,073	675,037	153,496	587,032	588,436	954,880	1,259,802	4,824,756
Mesabi Range								
Greenway	.....	.....	.....	.....	34,072	290,518	255,000	579,590
Draper	.....	.....	.....	.....	.....	39,125	181,010	220,135
Argonne	.....	.....	.....	.....	.....	371,773	608,000	979,773
Douglas	.....	.....	.....	.....	.....	.....	206,000	206,000
Bradford (a)	.....	.....	.....	.....	.....	46,695	19,300	65,995
Sliver	.....	58,104	16,172	34,250	53,355	77,792	82,975	322,648
Alice	.....	.....	33,252	122,313	54,224	109,539	314,000	633,328
Misc.	.....	6,369	.....	.....	74,485	.....	.....	80,854
Total Mesabi	.....	64,473	49,424	156,563	216,136	935,442	1,666,285	3,088,323
Vermilion Range								
Chandler	.....	.....	17,588	51,254	113,601	176,522	110,000	468,965
Fillmore County								
Weebing	.....	.....	.....	.....	.....	47	59,172	59,219
Total Evergreen Operations	606,073	739,510	220,508	794,849	918,173	2,066,891	3,095,259	8,441,263
Purchased and Trade Ores Utilized	219,405	487,381	107,572	206,359	493,351	474,191	408,448	2,396,707
Grand Total Shipments	825,478	1,226,891	328,080	1,001,208	1,411,524	2,541,082	3,503,707	10,837,970

(a) Bradford was worked out in 1942.

west end of the range, to Virginia, 60 miles to the east, where the Sliver and Alpena are located.

During the past winter the Buckeye open-pit wash-ore property on the Mesabi was opened up and equipped with a washer. This was recently leased from the State of Minnesota. It is expected to yield 100,000 tons of concentrate in 1943 and 400,000 tons in 1944.

The Weebing mine, in Fillmore County, southern Minnesota, near the Iowa line, is outside the boundaries of the Lake Superior district. Here last year, solely to help the war effort and without government assistance, Evergreen, in conjunction with Winston Brothers, contractors of Minneapolis, opened some substandard deposits of limonite, in several relatively small mines. The company is the first to ship from this part of the State. This ore is sent to furnaces in Illinois, after being washed prior to shipment in a local plant.

Save for the two properties operated for the Hanna Ore Co., and three that are owned in fee, the mines worked by Evergreen are leased properties.

Mining is done with shovels, loading into trucks, save in the Evergreen and the Portsmouth-Wearne pits, where railroad haulage is used. Collectively for all three properties, the equipment that has been provided is as follows:

18 shovels, ranging in dipper capacity from ¾-cu.yd. to 2½-cu.yd. The latter selected because this is the largest shovel that can be put on a railroad flat car or a mine dolly car, without dismantling, and be moved from one property to another. All are crawler-type, full-revolving machines. They are powered with diesel or gas engines, the larger ones having diesels.

56 trucks, including twenty-six 15-ton (10-cu.yd.) rear-dump Euclids, having diesel-drive; five 6-cu.yd. diesel-driven Kohring Dumptors; twenty-four 4½-cu.yd. gas-driven International Harvester trucks; and one 8-cu.yd. truck of the same make and type as the foregoing.

4 steam locomotives. Two are 60-ton and two are 80-ton. Two are of Baldwin make and two American.

21 20-cu.yd. side-dump stripping cars.

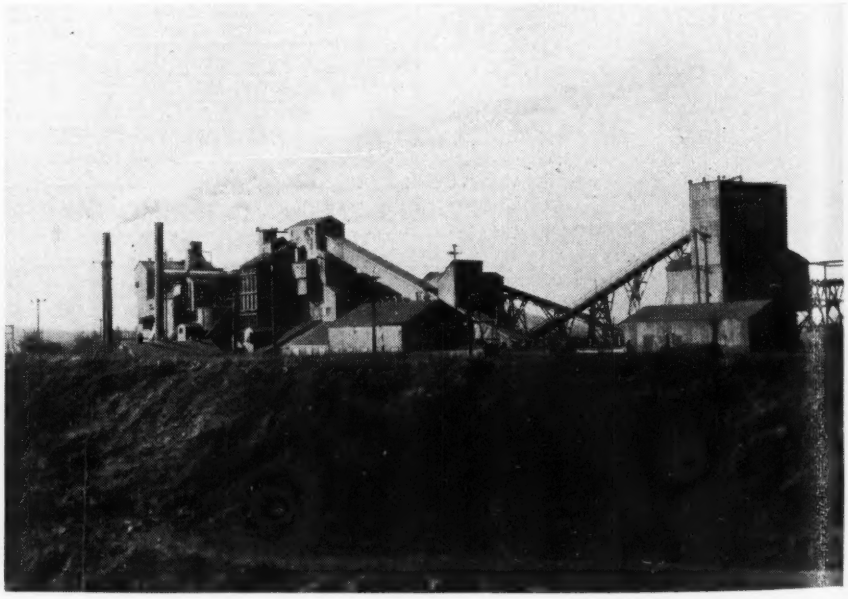
6 6-cu.yd. Bucyrus-Erie two-wheel scrapers.

14 tractors, including Caterpillar RD7's and RD8's, and International Harvester PD18's. The entire fleet is in bulldozer service, making roads, pushing dump materials.

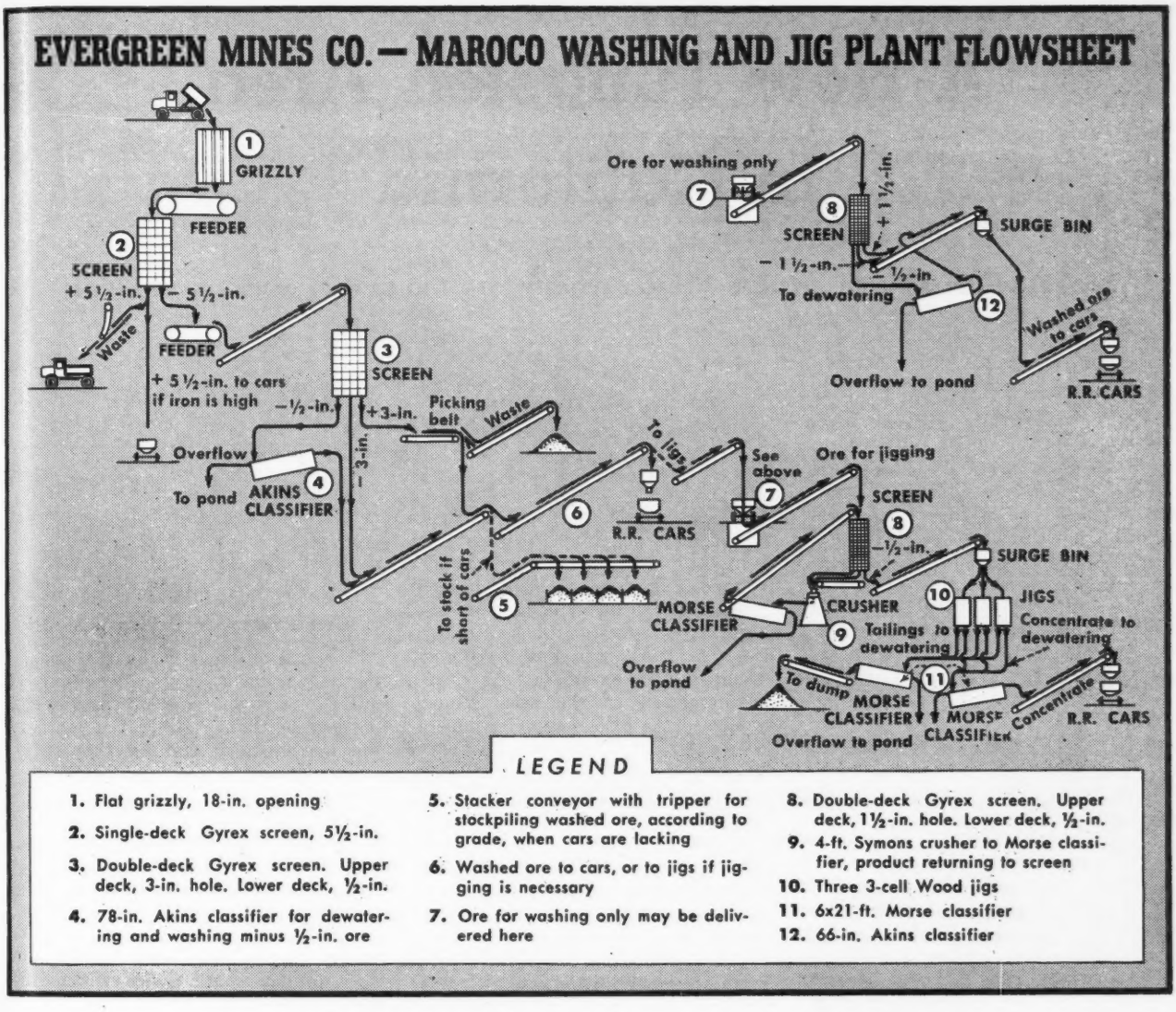
3 road graders, including two Austin Western 99's and one Caterpillar 112.

2 Bucyrus-Erie gas-driven blast-hole drills, T26 and T27, 6-in. hole.

In addition to the trucks, there are



EVERGREEN'S SINTERING PLANT is equipped in a flexible flowsheet to make four products: sintered ore, screened ore, crushed ore, and washed ore. Last year it turned out a total of 900,000 tons of these merchantable materials



EVERGREEN'S MAROCO PLANT is equipped to do both simple washing and jigging. As in the case of the sintering plant, the flowsheet, here shown, is flexible

three 16-cu.yd. and two 10-cu.yd. Athey wagons. These units are not in use at present. It is, moreover, impossible to obtain tractor equipment to haul them.

Of the plants operated by the Evergreen Mines Co., the sintering plant, situated on the Cuyuna on the edge of the open-pit mine known as the Evergreen, is by far the largest. The others are beneficiation plants, equipped either for washing or jigging, or simple crushing.

The sintering plant is a striking structure as it towers on the skyline, seen from a distance. It may be characterized as having four purposes: that is, it is equipped in an exceedingly flexible flowsheet for sintering, crushing, screening (the oversize being shipped and the undersize sintered), and washing. Thus it can make four products: sintered ore; screened ore; crushed ore; and washed ore. Description is limited to presenting an up-to-date flowsheet. In 1942 the plant turned out 900,000 tons of product.

As to the other plants, the Maroco mine is equipped with a washer and a jigging plant. Its flowsheet is given. The Huntington has a crushing unit which also serves the Maroco, Alstead, and Pennington. A crushing unit at the Sliver serves the Alpena also. The washer at the Greenway mine has been supplemented by a jigging plant installed last winter. The Argonne and Draper each has its own washer and the Douglas also is being so equipped.

For its multifarious operations, the Evergreen company employs a total of 1,000 men in summer. Of these 400 are on the Cuyuna, 300 on the western Mesabi, and 300 on the eastern Mesabi. In the winter this force will shrink to about 850 men for the three districts.

Under Mr. Harrison are D. C. Pettijohn, general mine superintendent, and Stanley D. Troyer, general plant superintendent. For operating supervision the company's properties are divided into three groups. Those on the Cuyuna Range are under Hugh Leach, as district superintendent. W. L. Taylor is district superintendent for the Eastern Mesabi and the Vermilion Range, and Hugh H. Harrison holds a like position for the western Mesabi. Nelo Hill is chief clerk and assistant to the general manager; Fred Engel is chief ore grader, and A. W. Kangas chief mining engineer.

To Mr. Harrison's courtesy we are indebted for the information and illustrations here presented.

Evergreen's operations are interesting on several counts. The sintering enterprise dominates the picture. Even as the "edifice" in which it is conducted commands the landscape, it seems to reflect the vigorous personality of Mr. Harrison. The company's expansion in the last two years is no doubt due in part to the war demand for iron ore. Yet it was already making good progress before the conflict.

A New Tungsten Area in California

Scheelite deposits in eastern Fresno county are thought to offer possibilities

Andrew Thickstun
Consulting Mining Engineer
Fresno, Calif.

LATE IN 1939 it was apparent to all geopolitically minded mineralogists that the United States would soon be in need of domestic supplies of strategic minerals. Tungsten would be one of them. Prospecting of unknown or little known regions, where quantities of commercial tungsten ores might reasonably exist, was in order. In a well-planned search for a high-temperature mineral like scheelite, the thoughtful investigator naturally selects areas wherein erosion has exposed rocks that during the epoch of mineralization were sufficiently deep and close to the source of mineralization to be eligible as host rocks. A careful study of the portion or region dealt with in this article—the great Sierra Nevada granodiorite batholith—disclosed a mean erosion of all but the lowermost zones. It therefore followed that segregations and pendants of roof materials found thereon must be exposed down to the tungsten and tin zones. The existence of very old lime-bearing rocks extending parallel to the axis was established. Here, in theory at least, was the making of scheelite—tungstate of lime.

AT THE GARNET DYKE MINE, operated by the Sheridan Brothers. A view of three adits and the concentrator. Elevated area in background is a cupola

Examination of the area geology established the existence of innumerable stocks or cupolas, the domes which served the hot mass of the magma as does the dome on a steam boiler. Like the safety valve on the boiler, the vents or shrinkage cracks in the hardened hood of the cupolas served to release the accumulated pressure of the still molten interior or core of the magma. It was through these cracks that the gases and solutions found egress. The locations where these escaping fluids encountered lime are focal points of interest to the scheelite prospector.

Value of Aerial Survey

Economic considerations narrowed the choice of the area under discussion to the part below the snow line, as indicated in the accompanying map. The region between the snow line and a point downslope to where the Sierra foothill complex thickens beyond the possibility of economical prospecting was as carefully checked as conditions permitted. Grounding of civilian air planes after the attack on Pearl Harbor, making aerial reconnaissance impossible, was unfortunate, for the rocks of the region contrast nicely, as can be seen in some of the accompanying photographs, and can be readily identified by the experienced. This also applies to the northern portion of the area where thick stands of evergreen timber obliterate the horizontal view but aid in determination of the zone boundaries in photographs taken from directly overhead. The section lying south of Huntington Lake is covered with manzanita shrub and mountain laurel, with scattered copses of larger timber. Here, unobstructed views may be obtained for many miles. But here also advance aerial mapping speeds prospecting, as pictures taken directly overhead expose croppings, scarps, and dikes on both on both sides of the ridges at once, and save for the largest cupolas, all contacts from all sides are revealed and their individual relation to the whole is apparent at once.

Area Largely Undeveloped

The area outlined on the accompanying map is about 25 miles wide and 60 miles long, with the southeastern end marked by Kings River Canyon and the northwestern end by the Chowchilla. The upper reaches of the Sierra Nevada foothill complex constitute the boundary on the west, and a wavy line where the batholith's roof attains an elevation of about 3,500 ft. marks the eastern boundary. Eastward lies more potential tungsten country but heavy snowfall at these higher altitudes makes all-year operation difficult. In my opinion, many more small and medium-size mines will be developed in this region than those now operating. Moreover, it is quite possible that some large producers will be discovered, especially if the price of tungsten rises to a figure that will make 25 to 40 percent tungsten trioxide ore a commercial product. Much of the area still remains unprospected, principally because of the ruggedness of the area.

Within the last year, and after actual shipment of concentrates from the district had drawn attention to its possibilities, Metals Reserve Co. has sent in engineers for the purpose of passing on individual applications for RFC development loans. However, these men have not been equipped to deal with the broad development of the area as a whole. The roads of the region quite naturally follow the easiest grades and miss entirely the higher ridges and cupolas, where the contacts are exposed. There can be little doubt of the need of access roads. However, the actual building of these roads should be preceded by speedy, but nonetheless accurate, determination of the exact location of worthwhile deposits.

For instance, an access road from road's end above the Kings River fish

hatchery to Spanish Mountain, a distance of some 16 miles, would open up a very rich area unproductive at present due to absence even of good pack trails. If routed by the Garnet Dyke and Kings River mines, the road would permit the operators to replace their 25-ton mill with one of 150 tons daily capacity for which they now have blocked out and ready a two years supply of mill-grade ore. Their ultimate potential tonnage is several times this amount, but the operators are handicapped because they cannot move in heavy equipment by pack mule.

Starting from the foothill complex, the mean ridge-top elevation rises steadily eastward from a few hundred feet to 3,000 ft. elevation. On these ridges denuded granitic cupolas or stocks surrounded by roof pendants, as pointed out earlier, dot the entire area. Many of these pendants—remains of what once was country rock—are composed in part of lime-bearing rocks, calcite, blue lime, tactite, and marble, all being a part of a large lime-bearing bed now uptilted and in places altered by heat and pressure. This lime zone extends the entire length of the area from southeast to northwest, from the Kings to the Chowchilla rivers. The associated older rocks in the main are metamorphosed chert, shale, quartzite, and some almost completely altered rhyolite. In the denuded areas hood vents have been filled with pegmatite, some of which are barren and some of which are tungsten-bearing. In other cases, the filler material is quartz and quartz epidote. Of the latter a good number show scheelite in commercial amounts. Much original roof material has been eroded.

Typical Ore Composition

Although many interesting crystalline specimens of scheelite are found, in typical specimens of ore from this area, the mineral is so well disseminated through the ore that the crystals cannot be readily observed without the aid of a pocket lens. Under the fluorescent light they show as tiny pin points, and yet the ore assays up to 3 percent tungsten trioxide. In the concentrates shipped from different deposits some bismuth, tin, antimony, molybdenum, copper, and manganese are present, but not in detrimental proportions. The following analysis made by Twining Laboratories, Fresno, Calif., which acts as umpire analysts and weight checkers for practically all the concentrate of the region, is typical:

Tungsten trioxide	60.73	percent
Tin	.01	percent
Copper	.01	percent
Phosphorus	.058	percent
Arsenic	Nil	
Antimony	Nil	
Bismuth	.26	percent
Molybdenum	.08	percent
Sulphur	.061	percent

While milling of mined ores has presented difficulties in general, detrimental minerals have been low. So far no copper or sulphides in deleterious amounts have appeared. An over-tolerance amount of bismuth did appear in the concentrate from one newly established mill. A loss of $1.00 per unit had to be taken on the parcel after shipment. However, diligent research at the mill disclosed that the bismuth rode high on the Straub concentrating table. The difficulty was remedied by cutting grooves in the table at the indicated point and directing the bismuth into a separate container.

In my opinion an ideal flowsheet for handling the ores mined in the area is as follows: A primary crusher large enough to take rock fragments up to 200 lb. in weight. Heavy blasting, which shatters the brittle crystals of scheelite, is thus avoided. A secondary crusher, preferably a gyratory unit, is required to reduce the primary crusher product to minus $\frac{3}{8}$ in. Heavy-duty rolls are desirable but if a ball mill must be used it should be one with a low discharge to obviate slime troubles. Fine grinding of scheelite inevitably will bring about slime problems. Removal of all minus 14-mesh material immediately to prevent abrasion by pebble action should follow, using a classifier or screen. The oversize should be returned to the rolls or ball mill and the undersize fed to a table. Any of the standard concentrating tables properly adjusted as to volume of feed and water as related to grade and throw will make an economical recovery with a minimum tailing loss. Table middlings should be returned to table feed.

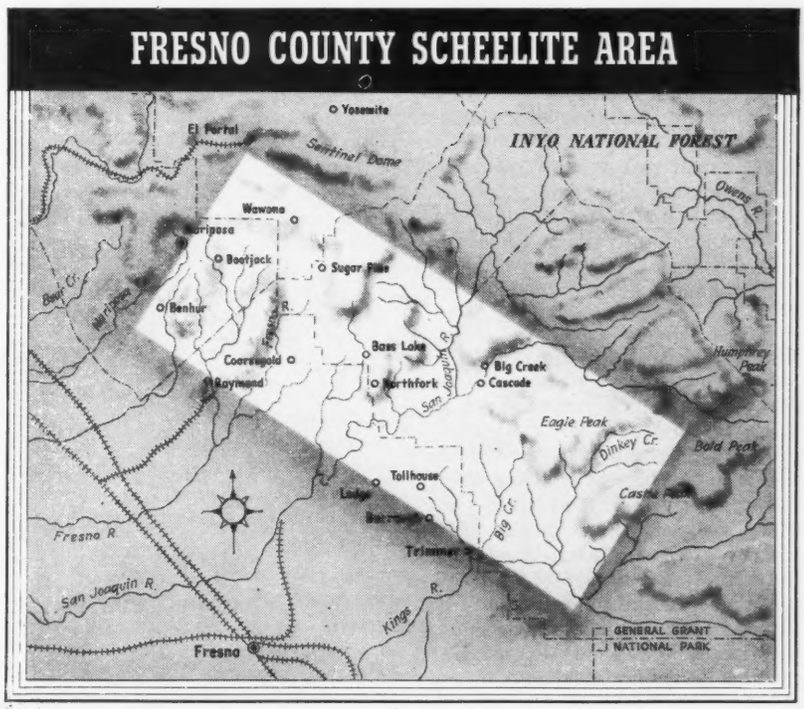
No evidence of tungsten ores other than scheelite have been observed to date in the district under discussion. However, no investigation of the Minarettes country has been made so far, and, as this area carries both iron and manganese in large amounts, it is probable that ferberite and huebnerite will be found. The region most certainly was subjected to invasion by solutions of the same nature as that under discussion. It is even possible that discoveries may be made of ferberite and huebnerite in commercial grade and volume.

Mines active in the district and producing from 5 to 400 short ton units of scheelite per month are as follows:

Kings River mine. Elevation 2,600 ft. Sec. 22, T. 12 S., R. 27 E., M. D. M. Deposition of scheelite at the contact of roof pendant and almost vertical side of granitic cupola, in crystalline lime. Garnet and quartz gangue. Quarrying operation, with output handled in a 30-ton mill. Aerial tram 500 ft. long is available.

Houghton Brothers mine. Elevation 1,800 ft. Situated on Dinkey Creek. Secs. 3 and 4, T. 12 S., R. 26 E., M. D. M. 20-ton mill. Ore is delivered by Caterpillar trailer. Another granitic cupola and crystalline lime deposition. Garnet and quartz-epidote gangue.

Parlier Prospecting Association's



POTENTIAL TUNGSTEN PRODUCERS somewhere within the light area shown here may be uncovered by systematic prospecting followed by access road building

DRILLING a typical quartz-epidote scheelite-bearing vein. Dark material on left is vein; lighter rock on right is altered limestone

Drum Valley mine. Elevation 1,500 ft. Situated 12 miles east of Rosa. Mined ore is shipped to a custom mill. Contact of granite and marble. Garnet and quartz ore. Large masses of very high grade material.

Qualls mine. Elevation 5,500 ft. Situated on Dinkey Creek near the lakes. Seasonal operation. Lime and granite contact. High-grade ore. Quartz-epidote gangue.

Remarkably Persistent Vein

Carruthers mine. Elevation 3,000 ft. T. & S., R. 24 E., M. D. M. Pendant overlooking the San Joaquin. Some tactite, and some blue lime. Remarkable quartz-epidote vein 4 ft. wide fills symmetrical vent crack in granite. The vein shows great persistence and strength for more than 800 ft. of exposed surface with apparent depth of 300 ft. It is said to assay an average of better than 0.32 percent WO_3. Lying along the east side of the vein and plunging directly toward it at 40 deg. is a mass of country rock of undetermined thickness, altered mainly to tactite and hard limestone. Interlain with layers of the roof material are layers of quartz-epidote up to 6 ft. in thickness carrying as much as 3 percent tungsten trioxide. An inclined shaft is down 60 ft. on this material. Values have consistently increased with depth, as has the thickness of the ore. No crosscutting has been done to determine the width of the orebody. Lenticular pockets of fine silt-like material follow the stratification. This material is heavily loaded with minute crystals of scheelite, and is said to assay 6 percent WO_3. Numerous smaller deposits scattered over the 9 claims and opened by quarrying show good ore. Most of them give evidence of having come from the quartz-epidote-filled vent mentioned previously. Mined ore is trucked to a 25-ton mill. John E. Winters, the new manager, plans a 100-ton mill to be installed downslope from the main orebody.

Wisseman mine. Elevation 3,000 ft. T. 7 S., R. 24 E., M. D. M. Another remarkable deposit within the same or a closely related roof pendant as the Carruthers mine. Lime granite contact. Quartz-epidote gangue. Large potential tonnage of high-grade ore of exceptional purity. Property is under bond and lease to Eastern business firm which pays the default royalty and allows the mine to lie idle. The owner is permitted to mine and mill as much ore as he can.

Strawberry claims. Elevation 7,000 ft. Situated near Timber Knob in the Jackass mining district. Owned by McDougald and Sons. It is claimed by reliable parties that development has uncovered an orebody 25x50x18 ft. dipping almost vertically. One truck load of this ore is said to contain 6 percent WO_3.

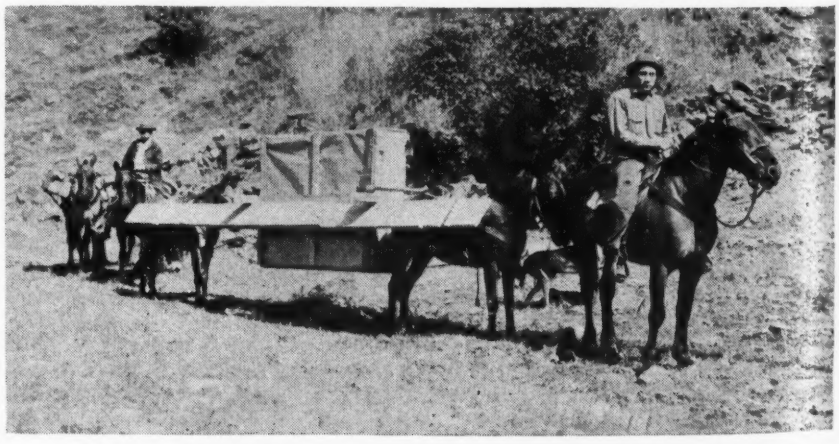
Garnet Type Ore

Sunset Group. Situated near Red Top Mountain, and managed by L. C. Thornton. Large potential tonnage and a 150-ton mill just completed. Contains primary crusher, gyratory crusher, rolls, and tables. A trial run was made when the first storm of the 1942-43 winter closed down the operation. Much of the ore is of the heavy garnet type. Two large veins show strength and persistence. Scattered over the area are numerous smaller operations in the development stage.

Garnet Dyke mine. Elevation 2,600 ft. Sec. 22, T. 12 S., R. 27 E. Owned by Sheridan, Bennet, and Kidder, and operated by Hal, Bill and Mike Sheridan, who have marketed an average of 200 short-ton units of tungsten trioxide per month for the last 1½ years. To accomplish this, it was necessary to sling a cable crossing over Kings River Canyon, build 8 miles of dizzy pack trail, cut a 25-ton Wheeler ball mill into mule loads and reweld it at the mill site. A Pacific jaw crusher, Straub table, and a small Caterpillar tractor and dozer were moved to the property in a similar manner.

Near Northfork, Coarsegold, and Bass Lake, in the Bass Lake district, a number of old gold mines in their underground operations have cut tungsten-bearing veins. The gold properties are situated, interestingly enough, in or around low or so-called "trough" cupolas. Several of these

PACKING EQUIPMENT into the Garnet Dyke mine. Many locations can be reached only by pack animal at present



properties are under investigation at the present time, particularly the Rapp lease three miles northeast of Coarsegold. More than 100 tons of ore were hauled several miles to a free-gold milling plant for test purposes, and a recovery of 0.75 percent WO_3 was reported. It is estimated that this was at best but a 65 percent recovery of the available value, with the exceptional tailing loss being attributed to the fine-grind gold mill technique. The Sunset Group and Garnet Dyke mine mentioned previously lie respectively at the northern end and southern end of this area.

Dr. F. E. Twining, scientist, and E. A. (Red) Wilkins, chief metallurgical chemist, Twining Laboratories, Fresno, Calif., have played an important role in opening up the district discussed in the foregoing article. Aside from instituting a comprehensive educational campaign, all facilities of the laboratory were placed behind the new development in an effort to open additional sources of tungsten.

Washington Reflections

(*Continued from page* 57)

selected labor markets of the Middle West. There is no information as to when the proposed plan will be put into effect.

Magnesium Problems

MAGNESIUM PRODUCTION is scheduled to increase rapidly during the last half of the year. First units of the government-owned plant in the State of Washington went into operation late in May (See page 102).

Fear has been expressed that the expected rate of magnesium production may be so much greater than consumption that an unwieldy surplus will result. Government officials believe that any surplus of magnesium is more apparent than real and will be temporary.

Behind the scenes the proposal was made that certain high-cost plants be closed down. However, no curtailment is expected. The armed services insist that the full capacity of the entire country can and will be used in a very short time. This may possibly be the beginning of a postwar scramble for position in the metal markets. No one knows what to expect from magnesium alloys. Speculation is that the battle lines will be drawn for a three-way fight, with magnesium alloys competing with aluminum and copper.

Longhorn Tin Smelter

OPERATION of the Texas tin smelter is now well into the second year. A survey of the first year's operation shows the tin situation improved. During the year, industry was permitted to use about as much tin as normally, and production of virgin metal at the smelter, combined with the substantial tonnage of reclaimed tin, has added a few thousand tons to the stockpile.

Great credit is due the metallurgists in handling the difficult Bolivian ores. American technical skill also has improved mining operations. Result is a greater tonnage of ore being brought to the surface with more tons of metal being recovered per ton of ore taken from the ground and a higher percentage of metal in the concentrates shipped from Bolivia to Texas.

Official Washington is giving thought to whether or not the Texas smelter should be kept in operation after the war, using the Malayan ores rather than those from South America. It is claimed that the operation could be maintained without subsidy. There are some officials who believe a small subsidy should be provided if necessary. This idea appears to lack Congressional backing at the moment.

About Face on Lead

THINKING in the lead industry concerning the lead stockpile has undergone a reversal because of changed conditions. F. E. Wormser, secretary of that industry's association, accurately expressed the previous feeling of the industry when he wrote (*E. & M. J.*, February, 1943, p. 67). "The federal government is now in the lead business in more ways than one, and its proprietary interest in a large stockpile may create new problems after the war, but right now the plentiful supply provides an opportunity to use lead to relieve, in some measure, the burden being thrown on copper and zinc (which have a more direct military application than lead), and on tin, aluminum, chromium, cadmium, nickel, mercury, and steel."

Decline in the size of the stockpile, which was predicted by the government officials responsible for its creation, has come to pass. Predictions were based on general increases in the use of lead as well as its substitution for other scarcer materials. But, in addition, domestic production declined because of manpower shortages.

So much was said about the size of the government stockpile that arguments were advanced that lead mines should be closed and lead miners transferred to other fields where their labor could be made more useful to the war effort. Publicity concerning the abundance of lead, for which the industry is somewhat responsible, also had an adverse effect upon mine labor. Many men left the mines for war industries and the production of the men remaining in the mines declined.

The manpower situation at the mines has been further aggravated this year, as in previous years, by the seasonal trek of some miners to the farms. As a result domestic production has dropped off and supplies of lead have been taken from the stockpile at an increasing rate since March.

These conditions were aired at the June meeting of the Lead Industry Advisory Committee. It was followed by a War Production Board announcement that while this nation has ample supplies of lead on hand and in production to meet all current and foreseeable military requirements as well as essential civilian needs, conditions are variable and a continued decline in production might change the picture drastically, as the United States is far from self-sufficient. Large quantities of lead must be imported, principally from Mexico, and current receipts might be increased if shipping permits.

Though lead supplies are getting tighter, that does not mean that it should not be substituted for more critical metals, for various adjustments could be made to assure that lead be made available for the most essential war production, the WPB said.

Suspension of Assessment Work

IT WAS ERRONEOUSLY REPORTED in Reflections for May that the McCarran bill, extending the expiration date for the suspension of assessment work to July 1, 1944, was passed on April 24. Actually, the bill was passed by the Senate, but the bill of Congressman Murdock, passed by the House on the same day, was accepted by the Senate and sent to the President, who signed it on May 3. This act, now recorded as Public Law 47 (78th Congress), is more liberal than the McCarran bill, as it extends the suspension of assessment work until six months after the war. Also, the McCarran bill, by proposing to extend the 1942 act, was limited to six lode or twelve placer claims. Public Law 47 is an amendment to the statute and has no such limitation. Owners of claims should file affidavits of intention to hold their claims on July 1 of each year that suspension is in effect.

Mine Relief Bill

THE McCARRAN BILL, providing for suspension of obligations for mines which have been forced to shut down because of government orders, came up for Senate consideration on June 15 but was passed over because of the objection of Senator Taft, of Ohio,

(*Continued on page* 125)

Structure Chart for Solving Geological and Mining Problems

A speedy method for work in the field

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CERTAIN PROBLEMS in structural geology involving intersection of planes or lines are likely to be troublesome, particularly when the work must be done in the field away from drafting facilities. Even granted all the necessary drafting equipment, the methods of ordinary descriptive geometry require close step-by-step attention and considerable time. Simplification in the solution of several common problems may be achieved by the use of a diagram whose manner of construction serves to illustrate the principles of its operation. For illustrative purposes (see Fig. 1) such a diagram may be constructed as follows:

A nail is driven perpendicularly into the flat surface of a board so that the nail head stands a few inches above the surface. To the head of the nail a string is attached. If the free end of the string is held at various points on the board, the angle between the string and the board may be adjusted at will and measured with a protractor. For a given angle, it may be noted, the string will touch the board on a particular circle with the nail at its center. It follows that circles representing various angles of pitch or inclination may be drawn and labeled.

If radial lines representing geographical bearings are now laid out on the board with the nail as the center, evidently the string may be used to designate lines of any given pitch or any bearing or of both. Further, if the lines so constructed are considered as dip lines of planes, the planes themselves may be represented as traces on the board. The labeled coordinates of the point at which a trace falls tangent to a circle defines a plane in terms of its dip and its dip direction. To summarize: Any pitching line may be represented on the diagram as a point, and any dipping plane as a line.

A more practical method for the construction of the diagram to any desired size would be to locate the interval between the center and each dip circle by plotting a cotangent of each dip angle along a linear scale. To visualize the three-dimensional aspect of each operation on the diagram, it would be well to keep in mind a fixed point on a central axis through which all constructed planes and lines must pass. The height of this axis would be equivalent, necessarily, to the distance from the center of the diagram to the 45-deg. circle. The range of usefulness of the diagram may be demonstrated by setting up a few typical geological and mining problems and indicating their solutions. A celluloid protractor or triangle and a pencil are the only accessories required.

Five common problems and their solution with the aid of the diagram are presented:

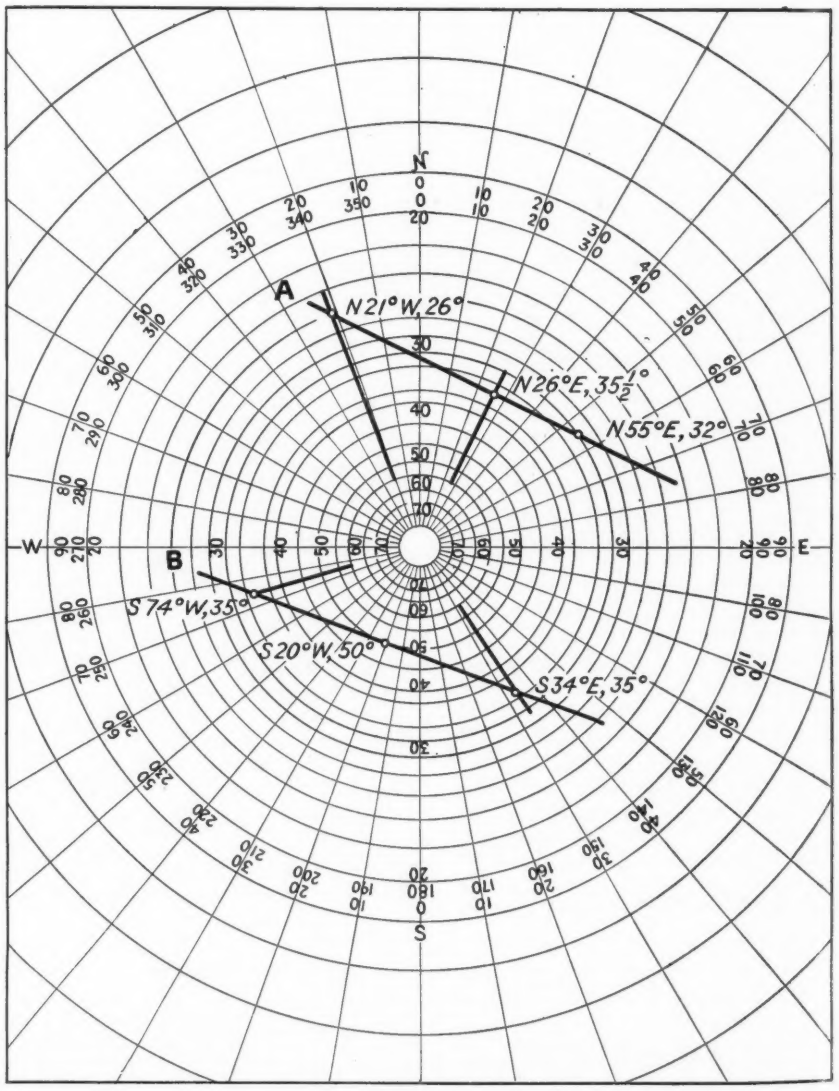


Figure 1

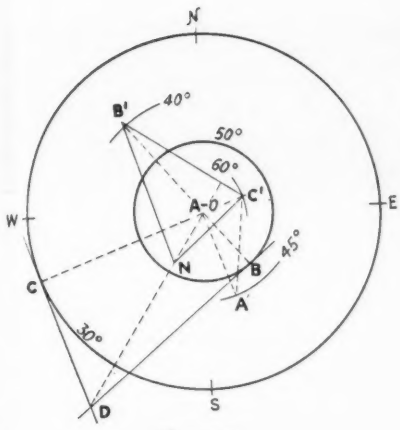


Figure 2

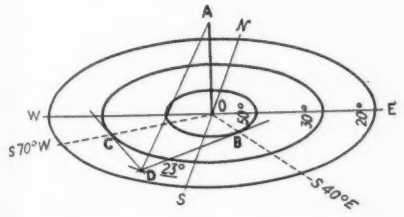
1. The Pitch and Bearing of the Intersection of Two Planes

In Fig. 2 the line BD represents the trace of a plane passing through the point A and has a dip of 50 deg. in a direction S. 40 deg. E. This plane is intersected by another plane whose trace is CD and has a dip of 30 deg. in a direction S. 70 deg. W., also passing through the point A. The intersection of the two planes is in the line AD, whose dip is read on the circle D and whose direction is read on the radial line OD—namely, —23 deg. S. deg. W.

2. The Apparent Dips of Planes, Cut by Geological Sections

The problem of determining the apparent dip of a plane cut by a geological section may be considered as a case of the type illustrated in Fig. 2. Regarding the vertical plane OAD as the plane of section, the plane ABD would appear in the section as a line having a dip of 23 deg. in a southerly direction.

Figure 3



3. Two Components of Dip Define a Plane

Given two lines in a plane such as two components of the dip of a vein measured on opposite sides of a hill. Determine the strike and dip of the plane. The bearing and pitch of the two lines are respectively N. 55 deg. E., 32 deg., and N. 21 deg. W., 26 deg. These lines are plotted as points (Fig. 1) by their coordinates as indicated on the diagram. The line connecting the points is a trace of the plane sought. Its dip direction is read as N. 26 deg. E., corresponding with a strike of N. 64 deg. W. Its dip is 35½ deg.

4. Three Points Define a Plane

Given three points in a plane, find the strike and dip of the plane. By presenting these data, either by measurement or calculation, in a form giving the bearings from the highest point A to the lower two, B and C, and also the slope angles from A to B and A to C, this problem becomes identical with problem 3.

5. Line Elements of Planes

An orebody lies in a vein dipping 50 deg. in a direction S. 20 deg. W. (strike N. 70 deg. W.). It is desired to run a raise having a slope of 35 deg., the minimum angle at which the ore will flow. What would be the bearing of such a raise? The trace of the vein is plotted as in Fig. 1. This trace crosses the 35 deg. circle at two points bearing S. 34 deg. E. and S. 74 deg. W. respectively. This problem is the converse of problems 3 and 4.

6. The True or Dihedral Angle Between Two Planes.

This problem may be solved by first constructing perpendiculars or poles to the given planes. These poles will appear on the diagram as points opposite to and with pitch angles complementary to the dips of their respective planes. The pole points on the diagram form the base of a triangle whose apex angle, the supplement of the angle sought, falls on the imaginary axis of the diagram. By means of the following constructions this triangle may be represented in its true dimensions and the dihedral may be measured. Given the two planes ABD and ACD illustrated in Fig. 2. The poles of these planes appear as points B′ and C′ in Fig. 2. The angle C′AB′ of the inclined angle C′AB′ is the supplement of the angle sought. If the vertical triangle C′OA is rotated about its base C′O until A is in the plane of the chart, A will necessarily fall on the 45-deg. circle at A′. The side C′A′, now in its true dimension, is also a side of the triangle C′AB′. If triangle C′AB′ is also rotated about its base C′B′, its apex A will fall along the line OD. If, therefore, the length C′A′ is scaled from C′ along OD, it will fall at N. The angle C′NB′ is the supplement of the dihedral angle projected into the plane of the chart. The dihedral may be measured directly by extending sides B′N and C′N.

A graphical method has been described for the rapid solution of several types of problems involving intersecting planes and line elements of planes. Besides having speed and accuracy, the method promotes awareness of the true spatial arrangement of the elements dealt with—a quality often sacrificed in other graphical and analytical devices. The illustrative problems should suggest other applications for the methods, as, for example, the solution of certain vector problems or the recording of geological field data.

Flake Mica Sized Electrostatically

PROCESSES have been developed in recent years by which fine flaky mica particles can be mixed with suitable binders and formed into materials of extreme durability such as radio insulators, panels, plastics and moulded hard rubber. More widespread use of the possibilities of these methods has been retarded, however, because of the impossibility of obtaining a properly sized mica product. It is, of course, possible to secure mica flakes of uniform area by means of simple screen sizing, but an entirely satisfactory product cannot be obtained unless these flakes are also sized as to thickness. In Bureau of Mines Report of Investigations, No. 3662, Oliver C. Ralston, principal chemical engineer, and Foster Fraas, assistant chemist, describe a new method for thickness-sizing of mica flakes.

Ground to a powder, the mica is sized by screening in the usual manner, and each size fraction is then passed separately over a shaking table which is subjected to electrostatic charges from a grid electrode suspended above and parallel to the table. The sizing effect derives from the fact that the thinnest mica flakes are supported most strongly by the electrostatic charge, and are therefore least affected by the movement of the table. The "tailing" of the table thus contains the thinnest particles, and the "concentrate," the thickest.

Test batches of the closely sized mica product have been found superior to the ordinary screen-sized mica powder for use in industry, and a means is thereby afforded for utilizing quantities of mica flakes and fragments which are now being discarded for lack of a proper grading method.

Mine, Shop, and Plant

Insurance for Drilling

ALTHOUGH hard to believe, a rock drill, despite the battering service which it must perform, is built with the precision that characterizes the making of a fine watch. Some of the parts must be machined to within 0.0005 in. of their specified dimension (0.001 in. is less than one-third the thickness of a sheet of newspaper). The rock drill must also be durable and sturdy. The piston, for example, strikes 1,800 to 2,200 blows a minute against a drill steel shank. For it to stand up against such punishment, special attention must be devoted to materials, machining, and heat-treatment. The average drifter piston requires about 55 hours to make; yet it can be spalled or broken through careless, improper operation. This and the following comes with the authority of the Compressed Air Institute.

As received from the factory, the air hammer or drill should have a carefully applied coating of oil or grease on all working surfaces; but when it is placed in service, the oil reservoirs must be filled with the proper type of lubricant. Use of air-line lubricators is recommended, and they too should be filled with a good grade of rock-drill oil.

Before the air hose is attached to the drill or hammer, it should be blown free of dirt or particles that may clog the tool and cause serious damage. Air in the line should be free of moisture, which is most damaging to air tools because it washes away the lubricant, may freeze the valves and ports, and is harmful in other ways. Intercoolers, after-coolers, and water traps all contribute to drying the air.

The user should be instructed in the fundamentals of good rock drill operation. One of these is the proper method of handling the drill. The instructor should emphasize how important it is that the machine be kept in line with the drill steel. When the drill is out of line, chuck bushings wear rapidly; and when this occurs the piston strikes the corner of the drill steel, and spalling results.

Holes drilled by dry hand-held sinkers should be blown frequently to keep the bit from binding. If drilling is done in moist ground, a wet machine should be used. The water flowing through the drill steel will prevent plugging of the bit and will also prevent "mud collars," which often stick the steel.

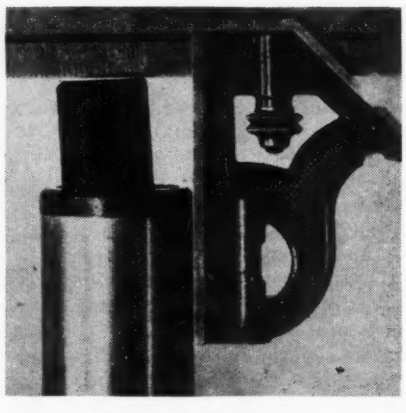
Failure to keep the bit properly sharpened is one of the most frequent causes of bit breakage. Dullness, in addition to lowering drilling efficiency, puts undue strain upon the wings.

Drill shanks that are too long or too short should be avoided. Drilling speed is reduced when the shank is too short, because the piston does not strike with full force. Long shanks tend to short-stroke the machine, again reducing the power of the blow. The manufacturer's instructions regarding the proper length of the shank must be followed carefully.

The cylinder front washer in the drill should never be permitted to become excessively worn, because this will destroy the cushion at the front end and cause breakage of front-head parts and pistons. Neither should chuck bushings in the drill be permitted to wear unduly, for this will prevent the piston from striking its blows squarely on the shank of the drill steel—which in turn will cause the piston to spall or fracture. The chuck bushings may wear out prematurely if the diameter of the drill-steel shanks is too small or if the machine is not in line with the drilled hole. The end of the shank should be ground square so as to distribute the force of the blows evenly over its surface.

In short, any working part in the drill that becomes worn should be given attention immediately.

Much scoring can be prevented by lubrication. A lubricator in the air line is recommended and can be easily and quickly installed. It feeds oil into the air line by means of an adjustable needle valve. The atomized lubricant from this important accessory will flow at a temperature determined by the grade of oil used.



WORN CHUCK BUSHINGS cause play in the drill shank

Oil used in sinkers, stopers, and drifters should be well-refined petroleum oil, clear and free from suspended matter and water; or be a well-refined petroleum oil compounded with a sufficient quantity of animal oil to form a satisfactory lubricant for rock drills where water or wet air is encountered; or should be a good grade of free-flowing liquid grease which will not separate upon standing.

Castor machine (aluminum soap) oils, or oils containing graphite, are not approved.

The following physical properties are representative of oils found satisfactory under actual commercial service in the field, and all oils purchased to this specification shall conform to these requirements:

Flash point (open cup)	350° F.	Min.
Viscosity at 100-F (Saybolt Universal)	450 Sec.	Min.
	700 Sec.	Max.
Viscosity at 100-F (Redwood)	380 Sec.	Min.
	600 Sec.	Max.
Viscosity at 100-F (Engler)	12.4°	Min.
	19.0°	Max.
Pour point	15° F.	Max.
Mineral acid neutralization number	0.10	Max.
Free fatty acid (% oleic)	0.40	Max.
Steam emulsion number	300	Min.

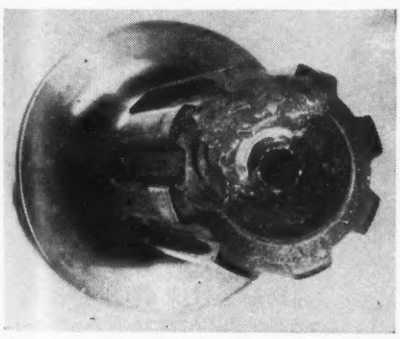
Viscosity cannot always be determined on liquid greases, and in this event the lubricant should be free-flowing and should conform to the specifications shown in the table except for viscosity.

All tests should be made according to standard methods of the American Society for Testing Materials.

Drill steel for rock drills should be of the type that will withstand repeated forgings and poundings. An ample supply of sharpened steel should always be kept on hand to prevent work stoppage. When in storage, drill steels should be kept sorted so that the operator or blacksmith does not have to rummage to obtain the proper type and size. Detachable bits eliminate the need for hauling large quantities of steel back and forth between the forge shop and the job, and they also reduce the amount of steel tied up in one place. Most sizes of detachable bits may be reground several times.

The shank ends of the drill steel and the ends of the pistons in the rock drills should be ground square; however, it is wise not to grind too much steel off the piston end, because there is danger of exposing the soft core of the metal. Time consumed in forging shanks can be reduced by the use of drill-steel sharpeners, which accurately form the hot metal into the proper shape.

When forging a bit, the blacksmith must not only use the utmost care in shaping the piece, but he must also pay careful attention to the heat-treatment. The bar steel to be forged should be carefully handled, because any nick on the surface may be the origin of a fracture. When the steel is heated, the heated area should be no longer than is necessary. (Drill-steel forging temperatures should be kept between 1,900 and 2,100 deg. These temperatures color the metal orange to lemon yellow.)



PISTON spalled on striking face. Do not use shanks that are not properly ground square.

Steel should not be kept at the higher temperatures longer than necessary; for high temperatures induce decarburization, which reduces wearing and cutting qualities.

When drill steel is forged, particular attention should be given to the hole that extends through the inside of hollow steels. If this hole is too small, it will restrict the flow of air or water; and in the case of wet machines it will damage the water tubes.

Bits are hardened by heating to 1,450 deg. F. The end should be submerged in running water or brine to a depth of ¾ in., and when the color fades completely, the entire heated end of the bar should be submerged and allowed to cool. If the ground water in a given locality is alkaline, rain water should be used. Drill shanks should be heated to 1,550 deg. F. and quenched in quenching oil, which should be circulating. Hardness of shanks should be kept between 350 and 400 Brinell.

Rock drill parts will break if the air pressure is too high. Low air pressure also should be avoided as it is especially damaging to stoping drills, as it will not hold them up to the work properly. Water pressure in drills should not be higher than the air pressure, for if it be higher, it will drive water into the drill mechanism and wash away the lubricant, and the driller may continue without knowing this.

Inspection should be made at frequent and regular intervals.

Lifting Has Its Hazards

TO WEIGHT LIFTING done carelessly or by the wrong person many disabling injuries are due. Production is lost, manpower is wasted, somebody suffers. Yet the subject is seemingly commonplace and the average man thinks he knows all about it.

Credit is due the Labor Department at Washington for an analysis of the subject and for recommendations. To give the argument added force, the point is made that *safe* methods of lifting and carrying are more efficient.

Lifting injuries are largely due to undue strain on certain muscles and tendons brought into play by lifting or carrying. This strain may be due to (1) Lack of lifting or conveying equipment. (2) Overtaxing physically fit workers. (3) Lifting the wrong way. (4) Lifting done by physically incapable persons. (5) Where two or more men are lifting together, too heavy a share of the load on one. (6) Tripping and slipping, insecure footing.

Elimination of the hazards that cause injuries calls for attention to:

1. Over-all planning of process and work methods. This is a job for management. It includes an analysis of all lifting and conveying problems to determine type and amount of work to be done in the work day. Mechanical lifting and conveying equipment should be installed wherever practicable. The amount and pace of the work to be done by individual employees should be controlled.

2. Selection of physically qualified employees. General rules should be laid down by the management, and the supervisors should adhere to them. Workmen should be classified as to suitability for manual lifting. Those assigned to jobs requiring heavy or repetitive lifting should be carefully selected. For "team" lifting, choose men of like stature and physique.

3. Men should be trained in correct methods of manual lifting and use of mechanical equipment. No one should be allowed to lift or carry weights until then. Note the following:

In "solo" lifting a man should face the object with feet far enough apart (the length of the shoe is a good guide) to give a good base of operation without placing undue strain on the abdominal muscles. He should adopt a stance which is comfortable and which will permit him to lift the job as nearly straight up as possible. Next, he should get down to the job by bending his knees, keeping his back erect.

Then, he should raise the weight gradually (a sudden effort invites strain) by straightening his legs, taking the brunt of the strain upon his leg and shoulder muscles.

Heavy work should be done with mechanical equipment where available; otherwise with the assistance of other men assigned by the foreman.

In "team" lifting, the efforts of the various men must be completely coordinated, directions being given by one, and only one, member of the "team."

4. Continuous and careful supervision is fundamental in accident-free lifting and conveying. Available mechanical devices should always be used for heavy or repetitive work. Manual lifting should be done only by those who are qualified by physique and training. Workers should always lift in accordance with instructions. Unless the foreman makes sure that the work is done with the proper equipment, by the right workers, in the correct manner, the overhead planning and the selection and training of workers may be of little value.

Good plant housekeeping is as essential in safe lifting and carrying operations as it is in all phases of accident prevention. A company which takes all of the steps outlined in the foregoing but fails to keep a clean and orderly workplace will have workers injured while lifting and carrying. Aisles should be well marked and clear of obstructions. Floors and stairways should be kept in good repair and free from oil, grease, water, and debris. The entire plant, including stairways and ramps, should be well lighted.

Mechanical equipment helps to reduce injuries due to strain by eliminating manual lifting and carrying. Such equipment also results in more efficient production, and in the performing of heavy or repetitive work much more rapidly than otherwise.

Such equipment need not always be complicated or costly. Often the solution of the lifting or conveying problem is as simple as a rope hoist, a wooden chute, a hand truck, or a homemade gravity conveyor. Where conditions justify the expenditure, it is well to provide such equipment as electrically powered trucks which load, convey, and stack, or powered horizontal or vertical conveyor systems. These latter lead to more efficient production, but the simpler "gadgets" are often effective in eliminating manual handling.

Useful Operating Ideas

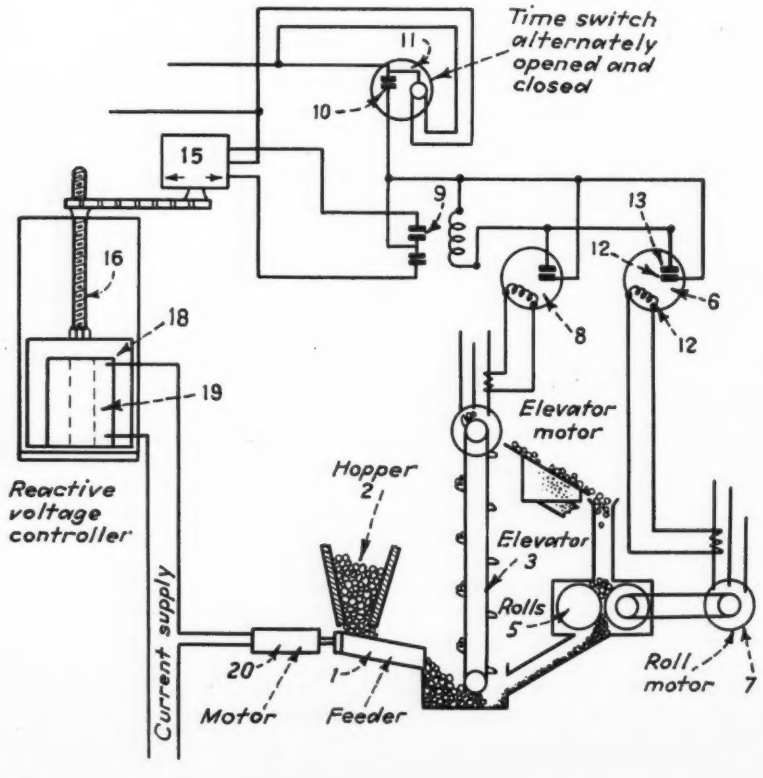
A Novel Automatic Control System

AN INNOVATION partly responsible for the record production currently maintained at the concentrators of Utah Copper Co. at Magna and Arthur, Utah, is the ingenious automatic arrangement explained in the accompanying illustration, designed to control and balance the divers units in the tertiary crushing sections. In the treatment of ore the raw feed supplied to each section is regulated to the full capacity of the weakest unit in the system. By so doing, the mill or concentrator is automatically maintained at its maximum efficiency or capacity at all times, regardless of any variation in the character of the material treated, such as a continuous change of hardness of the primary feed—a matter which may require more or less power for grinding.

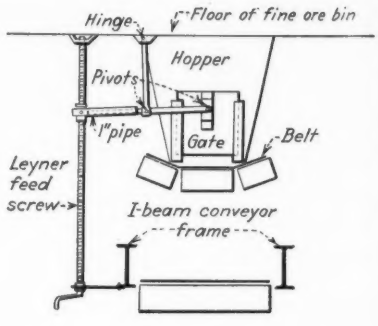
For example, material from the secondary crushing plant is fed by an electric vibrating feeder to a bucket elevator operating in closed circuit with crushing rolls, the vibrating screens between the elevator and rolls removing the finished product from the circuit. Now, if the ore is very hard, the rolls, will constitute the bottleneck of the circuit and take control of the feed, whereas the elevator will prove to be the bottleneck if the ore is soft. The tonnage of the circuit will then be governed by the capacity of the elevator to handle the greater primary feed plus the circulating feed.

The automatic control system shown consists essentially of an electric-driven feeder, 1, in the electric circuit of which is a voltage control mechanism in the form of a reactance coil in which the iron core is raised or lowered automatically so as to increase or decrease the voltage applied to the feeder, thereby varying the amount of primary feed flowing to the crushing system. The control is driven by a small reversible geared motor, 15, energized through time switch 11 and relay 9, which is in position to increase the primary feed each time switch 11 closes until either elevator motor 14 or the rolls motor 7 become overloaded. When this occurs, relay 6 or relay 8 may close to throw relay 9 in the opposite direction to reverse motor 15 so as to decrease energy to the electric feeder, thereby lowering primary feed input. Time switch 11 may be adjusted to make contact at the desired intervals and remain in contact any length of time desired, depending on the amount of primary feed change required at a given time. In other words, the system may be supervised by time switch 11 so as to give any degree of frequency of supervisory control.

The control system described varies from other automatic control arrangements in that it provides for maintenance of full capacity of the system as governed by the maximum capacity of any individual machine in the circuit and causes such control to follow the variables in the system. It was developed by H. E. Wurzbach, chief electrician, and a patent has been applied for.



Easily Controlled Gate For Fine-Ore Bin



SCRAP or discarded materials were used in making a gate control for the fine-ore bin conveyor belt feed system in operation for the past four years at the Gold Belt Mining Co., Ltd., Sheep Creek, B. C. O. C. Bellavance describes the construction of the unit, details of which are shown in the accompanying drawing. A discarded feed screw from a Leyner drill, a short piece of 1-in. pipe, and several short pieces of strap and round iron made up the list of materials.

Placing the handle of the feed screw at shoulder height permits adjustment of the gate from the mill floor, and a small amount of grease placed on the various sliding parts has provided smooth operation for four years with no further lubrication. The round iron rod placed in the pipe section should be about $\frac{1}{8}$ in. smaller in diameter than the pipe, and it should be long enough to allow for the necessary changes in length of the linkage as the gate setting is changed.

Straightening Steel in Drill Sharpener

TWO primary requirements in the present war effort are conservation of metals, materials, and equipment, and speed-up of operations. To operate machines with a minimum of shutdowns and improve or simplify working techniques means increased efficiency and steady output.

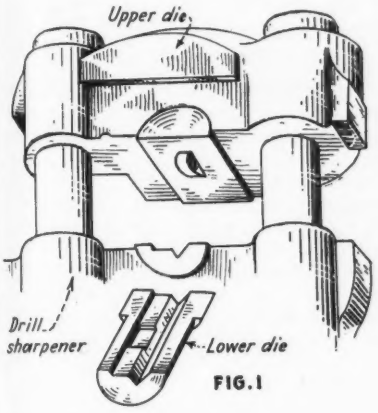


FIG. 1

For instance, at the drill-sharpening shop serving a mine or construction site a number of bent drills or shanks, where detachable bits are used, are brought in daily for subsequent reconditioning. In peace time, when materials can be obtained without difficulty, reconditioning of bent drills is not a rush matter, as plenty of new steel is always kept on hand. Today, however, the opposite is true—that is, all damaged drills must be fixed and returned underground with a minimum of delay. At the drill sharpening shop of Anaconda Copper Mining Company, Butte, Mont., this has been accomplished satisfactorily by employing a regular drill sharpener for straightening bent drills. As explained in the accompanying line drawings, use is made of two dies especially designed and made for the work as in Fig. 1, and a simple foot-pedal arrangement to operate the slow-acting valve on the sharpener as shown in Fig. 2, which permits the operator to use both hands when handling the bent length of steel.

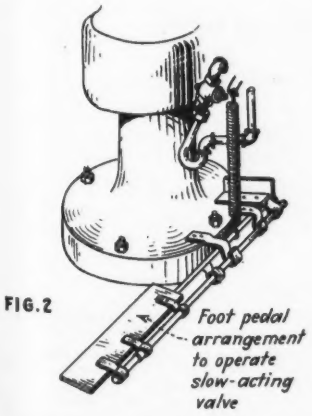
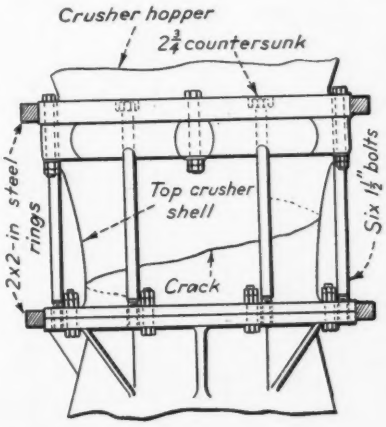


FIG. 2

Gyratory Crusher Repair

AT A LARGE gold-silver mine in central Mexico, breakage of the top shells of gyratory crushers used for reducing coarse ore caused temporary suspension of crushing operations, with consequent decreased mill output. The shells failed in the manner indicated in the accompanying sketch, which shows an incipient crack running practically around the shell and almost cutting the top off the bottom before entering the flange section.

The trouble seemed to arise from the fact that the shell between the two rings was not reinforced by ribs, as on many crushers of older design. Accordingly, the required stiffening of the shell was provided as shown. The two crusher parts have been bolted together, with steel bands shrunk on to the shell flanges preventing the bolts from breaking out. Both bands are made by welding together bars of 2x2-in. steel or wrought iron, and six 1½-in. bolts are used to tie the top and bottom pieces together. The reinforcing bands are made as nearly round as possible so as to make a tight fit on the shell. Next, they are placed around the flanges (not machined), and any places where they do not quite touch are filled with shims or wedges of steel. While the bands are hot the wedges are driven in tightly. Upon cooling, the bands shrink tightly on the flanges so that there is no possibility of breakage by strain from bolts that are later put in.



Holes are drilled in the flanges for 1½-in. bolts, with those in the top flange being countersunk to receive the heads of the bolts and thus provide a smooth face for the superimposed hopper flange, and those in the bottom flange tapped to catch the threaded ends of the bolts. In this manner the shell is bound tightly together and made almost as strong as it was when new. Some shells repaired by the method explained have been in use for many months, and give no sign of failure.

Five Dollars for an "Idea"

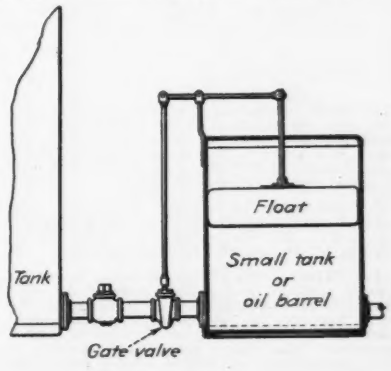
SHORTAGE OF EQUIPMENT in the present emergency puts a premium on the ingenuity of master mechanics and electricians to keeping mining and milling machinery running. If you have done an interesting job, just sketch or photograph it and send it in with a brief description. *E.&M.J.* will pay $5 for acceptable items.

Simple Device Regulates Flow of Liquids

AT MANY ore-treatment plants flow of solutions or pulp to different treatment units at a constant rate is important if optimum operating results are to be maintained. In normal times, when appropriate equipment can be purchased without restrictions, this is a relatively simple matter, but during the present emergency considerable ingenuity is often required.

The simple and inexpensive device explained in detail in the accompanying sketch has been found useful and effective in directing liquids from a storage tank to treatment units at a constant rate. It consists essentially of a small tank or large oil drum with a float, a quick-acting gate valve, and a simple lever mechanism connecting the valve with the float. Action is entirely automatic.

Any change in level in the storage tank, which alters the rate of flow through the discharge pipe, is automatically adjusted by a corresponding head in the small tank, the rising float lowering the gate in the valve chamber when the level in the storage tank is high, and the sinking float raising the valve gate when the tank head decreases. An even flow of solution or pulp is thus maintained at all times.



SUMMARY OF THE MARKETS

A REDUCTION IN THE freight rate on shipments of antimony from Laredo, Tex., was recognized by sellers in the New York area and resulted in a moderate reduction in the ex warehouse quotation to the basis of 15.839c. per pound for lots of 5 tons or more but less than a carload lot. The New York equivalent for antimony in bulk, carload lots, has been revised to 15.265c. per pound. Other price developments during June involved ferrochromium, chromium, ferromanganese, and manganese. OPA established specific maximum prices on these items, effective July 1. The ceiling prices, however, virtually conform with those that have been in effect for some time.

The *E.&M.J.* index of major nonferrous metal prices for June was unchanged at 88.74 for the tenth consecutive month. The average of the years 1922, 1923, and 1924 equals 100.

The job of obtaining more labor at the mines to increase production received attention in copper circles and in Washington. Production so far has been larger than in 1942, but WPB officials feel that a greater tonnage should come from the mines in the second half of the year. Imports have been maintained on a substantial scale. The price situation in copper underwent no change. It was stated officially that production in Canada accounts for 12½ percent of the United Nations' total supply of new copper.

To facilitate the movement of lead over crowded transportation lines during the months of lightest traffic, WPB amended the inventory order to permit consumers to add to their reserves. Domestic output of lead has declined over the first half of the year, owing chiefly to the labor situation. The notion that lead producers could spare workmen to facilitate operations at copper properties was dropped after a meeting of the advisory committee on June 17.

Production of zinc concentrate in the

UNITED STATES MARKET

1943 June	Electrolytic Copper: Domestic (a) Refinery	Electrolytic Copper: Export (b) Refinery	Straits Tin: New York	Lead: New York	Lead: St. Louis	Zinc: St. Louis
1	11.775	11.700	52.000	6.50	6.35	8.25
2	11.775	11.700	52.000	6.50	6.35	8.25
3	11.775	11.700	52.000	6.50	6.35	8.25
4	11.775	11.700	52.000	6.50	6.35	8.25
5	11.775	11.700	52.000	6.50	6.35	8.25
7	11.775	11.700	52.000	6.50	6.35	8.25
8	11.775	11.700	52.000	6.50	6.35	8.25
9	11.775	11.700	52.000	6.50	6.35	8.25
10	11.775	11.700	52.000	6.50	6.35	8.25
11	11.775	11.700	52.000	6.50	6.35	8.25
12	11.775	11.700	52.000	6.50	6.35	8.25
14	11.775	11.700	52.000	6.50	6.35	8.25
15	11.775	11.700	52.000	6.50	6.35	8.25
16	11.775	11.700	52.000	6.50	6.35	8.25
17	11.775	11.700	52.000	6.50	6.35	8.25
18	11.775	11.700	52.000	6.50	6.35	8.25
19	11.775	11.700	52.000	6.50	6.35	8.25
21	11.775	11.700	52.000	6.50	6.35	8.25
22	11.775	11.700	52.000	6.50	6.35	8.25
23	11.775	11.700	52.000	6.50	6.35	8.25
24	11.775	11.700	52.000	6.50	6.35	8.25
25	11.775	11.700	52.000	6.50	6.35	8.25
26	11.775	11.700	52.000	6.50	6.35	8.25
28	11.775	11.700	52.000	6.50	6.35	8.25
29	11.775	11.700	52.000	6.50	6.35	8.25
30	11.775	11.700	52.000	6.50	6.35	8.25
			AVERAGES FOR MONTH			
June	11.775	11.700	52.000	6.50	6.35	8.25
			AVERAGES FOR WEEK			
June 2	11.775	11.700	52.000	6.50	6.35	8.25
9	11.775	11.700	52.000	6.50	6.35	8.25
16	11.775	11.700	52.000	6.50	6.35	8.25
23	11.775	11.700	52.000	6.50	6.35	8.25
30	11.775	11.700	52.000	6.50	6.35	8.25
			CALENDAR WEEK AVERAGES			
June 5	11.775	11.700	52.000	6.50	6.35	8.25
12	11.775	11.700	52.000	6.50	6.35	8.25
19	11.775	11.700	52.000	6.50	6.35	8.25
26	11.775	11.700	52.000	6.50	6.35	8.25

SILVER, GOLD AND STERLING EXCHANGE

1943 June	Sterling Exchange: "Checks" (Nominal)	Sterling Exchange: "90-day demand"	Silver (c): New York	Silver (c): London	Gold: London	Gold (d): United States
1	401.000	(f)	44.750	23.500	168s	$35.00
2	401.000	(f)	44.750	23.500	168s	35.00
3	401.000	(f)	44.750	23.500	168s	35.00
4	401.000	(f)	44.750	23.500	168s	35.00
5	401.000	(f)	(e)	(e)	(e)	35.00
7	401.000	(f)	44.750	23.500	168s	35.00
8	401.000	(f)	44.750	23.500	168s	35.00
9	401.000	(f)	44.750	23.500	168s	35.00
10	401.000	(f)	44.750	23.500	168s	35.00
11	401.000	(f)	44.750	23.500	168s	35.00
12	401.000	(f)	(e)	(e)	(e)	35.00
14	401.000	(f)	44.750	Holiday	Holiday	35.00
15	401.000	(f)	44.750	23.500	168s	35.00
16	401.000	(f)	44.750	23.500	168s	35.00
17	401.000	(f)	44.750	23.500	168s	35.00
18	401.000	(f)	44.750	23.500	168s	35.00
19	401.000	(f)	(e)	(e)	(e)	35.00
21	401.000	(f)	44.750	23.500	168s	35.00
22	401.000	(f)	44.750	23.500	168s	35.00
23	401.000	(f)	44.750	23.500	168s	35.00
24	401.000	(f)	44.750	23.500	168s	35.00
25	401.000	(f)	44.750	23.500	168s	35.00
26	401.000	(f)	(e)	(e)	(e)	35.00
28	401.000	(f)	44.750	23.500	168s	35.00
29	401.000	(f)	44.750	23.500	168s	35.00
30	401.000	(f)	44.750	23.500	168s	35.00
			AVERAGE FOR MONTH			
June	401.000	.....	44.750	23.500	....	35.00
			AVERAGES FOR WEEK			
June 2	401.000	.....	44.750	.....	....	.....
9	401.000	.....	44.750	.....	....	.....
16	401.000	.....	44.750	.....	....	.....
23	401.000	.....	44.750	.....	....	.....
30	401.000	.....	44.750	.....	....	.....

Calendar week averages, New York Silver: June 5th, 44.750; 12th, 44.750; 19th, 44.750; 26th, 44.750.

(e) Not quoted (Saturday). (f) No quotations.

THE above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis add 0.225c. per pound, the average differential for freight and delivery charges.

(b) Export prices are net at refineries on the Atlantic seaboard and include sales of domestic copper in the foreign market. Owing to the World War and the disruption of normal trade relations, our export copper quotations, since September, 1939, have been based largely on f.a.s. transactions, ex United States ports. We deduct .05c. from the f.a.s. basis (lighterage, etc.) to arrive at the f.o.b. refinery quotation.

Copper, lead and zince quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingot bars; cathodes are sold at a discount of 0.125c.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East and Middle West in nearly all instances command a premium of 1c. per pound over the current market for Prime Western but not less than 1c. over the *Engineering and Mining Journal's* average quotation for Prime Western for the previous month.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

(c) Silver other than newly-mined domestic, by Handy & Harman. Under Treasury order of July 6, 1939, the price on domestic newly-mined silver mined subsequent to July 1, 1939, was fixed at 71.11c. per troy ounce. Handy & Harman's quotations on newly-mined domestic silver, 999 fine was 70⅝c. throughout June.

(d) U. S. Treasury's gold price. Actual payment by the United States Treasury for gold in domestic and imported ore or concentrate is at 99.75 per cent of the price quoted by the Treasury, which at present is equal to $34.925.

Tri-State district returned to normal after floods disrupted operations late in May. The industry was concerned about the larger supplies of High Grade zinc now available. The authorities in Washington decided to distribute some of the metal at strategic points in this country. Controls on use of zinc remain tight as ever.

Negotiations for a new settlement basis for obtaining Bolivian tin concentrates were in progress as June ended.

In the field of light metals, Phelps Dodge announced that it will engage in the manufacture of aluminum and magnesium in a plant that is to be erected by the Defense Plant Corp.

Effective July 1, OPA approved an increase in maximum prices of fluorspar amounting to $5 a ton. This was done to stimulate production to meet greatly expanded needs of the steel and aluminum industries. Part of the advance may be revoked after 60 days in the event that output lags.

MONTHLY AVERAGES

Monthly averages for copper, lead, zinc, tin, silver (New York and London), gold, and sterling exchange appear on preceding page. Average prices of miscellaneous metals for February and March follow:

	May	June
Quicksilver, N. Y. flask	196.000	196.000
Antimony (a)	16.049	15.855
Antimony, bulk, Laredo	14.500	14.500
Antimony, bulk, N. Y.	15.479	15.279
Antimony, Chinese (b)	16.500	16.500
Platinum, oz. troy	35.000	35.000
Cadmium (c)	90.000	90.000
Cadmium (d)	92.500	92.500
Cadmium (e)	95.000	95.000
Aluminum, ingot	15.000	15.000
Magnesium, ingot	20.500	20.500

(a) New York, packed in cases, in lots of 5 tons or more but less than a carload. (b) Nominal. (c) Producer's price for commercial sticks. (d) Average of producer's and plater's quotations. (e) Special shapes sold to platers.

E & M J PRICE INDEX

Weighted index of non-ferrous metal prices (copper, lead, zinc, tin, silver, nickel, and aluminum). The average for the years 1922-1923-1924 equals 100.

1929	110.33	1936	73.45
1930	82.87	1937	90.86
1931	60.20	1938	73.67
1932	48.26	1939	77.71
1933	59.79	1940	79.22
1934	69.59	1941	83.49
1935	74.66	1942	86.80

	1941	1942	1943
January	82.48	85.39	88.74
February	82.76	85.90	88.74
March	83.27	85.90	88.74
April	83.48	85.90	88.74
May	83.51	85.90	88.74
June	83.48	85.90	88.74
July	83.60	85.90	....
August	83.39	85.90	....
September	83.34	88.74	....
October	83.84	88.74	....
November	84.32	88.74	....
December	84.42	88.74	....

CURRENT PRICES — MISCELLANEOUS METALS, ORES, AND NON-METALLIC MINERALS

Quotations cover wholesale lots, prompt shipment, f.o.b. New York, unless otherwise stated

(July 1, 1943)

MISCELLANEOUS METALS

Aluminum, ingot, 99 plus per cent, lb	15c.
Antimony, domestic, spot, lb. 5 tons or more	15.839c.
Bismuth, ton lots, lb	$1.25
Cadmium, commercial sticks, lb	90c.
Calcium, lb., ton lots 97 @ 98 per cent	$1.25
Chromium, 97 per cent grade, lb	89c.
Cobalt, 97 to 99 per cent, per lb	$1.50
Nickel, electrolytic cathodes, lb	35c.
Magnesium, 99.8 per cent, carloads, lb	20½c.
Palladium, troy oz	$24.00
Platinum, (Official quotation) troy oz	$35.00
Quicksilver, flask of 76 lb., 100 flasks or more	$196.00@$198.00
Radium, mg. radium content	$25.00@$30.00
Selenium, 99.5 per cent, lb	$1.75
Silicon, minimum 97 per cent, spot, carloads lb.	14.75c.
Tellurium, lb	$1.75
Thallium, 100 lb. or more, lb	$10.00
Titanium 96 to 98 per cent, lb	$5.00

METALLIC ORES

Beryllium Ore, 10 to 12% BeO. f.o.b. mines, ton	(b)$100.00@$120.00
Chrome Ore, per long ton, f.o.b. cars Atl. ports, dry, 48% Cr_2O_3, 2.8 to 1 ratio	$41.00
48% Cr_2O_3, 3 to 1 ratio	$43.50
Iron Ore, Lake Superior, Lower Lake ports, long ton:	
Old Range bessemer	$4.75
Mesabi bessemer	$4.60
Old Range non-bessemer	$4.60
Mesabi, non-bessemer	$4.45
Lead (Galena) 80 per cent, Joplin, Mo., ton	$76.54
Manganese (dutiable) f.o.b. cars Atl. ports, long ton unit Mn:	
50 per cent	79.8c.
48 per cent	78.8c.
46 per cent	76.8c.
Manganese Ore, domestic, 48%, f.o.b. MRC depot, l.t. unit	$1.00
Molybdenum Ore, 90%, per lb. of MoS_2, f.o.b. mines	45c.
Tungsten Ore, per unit of WO_3:	
Chinese, 65 per cent, duty paid	(b) $24.00
Domestic, 65 per cent and upward	(a) $26.00
Vanadium Ore, per lb. of contained V_2O_5 f.o.b. mines	27.50c
Zinc Ore, Prime, 60 per cent concentrate, Joplin, Mo; per ton	$55.28

(a) Prices at mines, small lots, usually several dollars less. (b) Nominal

METALLIC COMPOUNDS

Arsenious Oxide (arsenic) lb	4c.
Cobalt Oxide, 70 @ 71 per cent, lb	$1.84
Copper Sulphate, 100 lb	$5.00

ALLOYS

Beryllium Copper, 2.5 to 3 percent Be, per lb. of contained Be	$15.00
Ferrochrome, 65 @ 70 percent per pound of Cr contained	13c.
Ferromanganese, 78 @ 82 per cent, gross ton	$135.00
Ferromolybdenum 55 @ 65 per cent Mo. lb. of Mo. contained	95c.
Ferrosilicon, 50 per cent, gross ton	$74.50
Ferrotungsten, 75 @ 80 per cent, lb. of W contained	$1.90
Ferrovanadium, per lb. of V, delivered	$2.70@$2.90
Silicomanganese, 1½ per cent C, gross ton	$135.00

NON-METALLIC MINERALS

Asbestos, f.o.b. Canadian (Quebec) mines (U. S. funds), ton:	
Crude No. 1	$650@$750
Crude No 2	$165@$385
Spinning fibers	$124@$233
Paper stock	$44@$49.50
Shorts	$14.50@$26.50
Vermont, f.o.b. Hyde Park:	
Shingle stock	$62.50@$65.00
Paper stock	$44.00@$53.00
Shorts	$14.50@$28.50
Floats	$19.50
Barytes, long ton:	
Georgia, crude	$8.50@9.00
Missouri, 93 per cent $BaSO_4$, less than 1 per cent iron	$6.75@$7.25
Bauxite, long ton:	
Domestic, crude, 50 @ 52 per cent (not dried)	$5.00
Domestic, chemical, 55 @ 58 per cent	$7.50@$8.50
Domestic, abrasive, 80 @ 84 per cent	$16.00
China Clay, f.o.b. mines, ton:	
South Carolina and Georgia, No. 1, bulk	$6.75@$8.00
Delaware, No. 1	$15.00
Feldspar, bulk, ton:	
Potash feldspar, 200 mesh	$17.00
Glass-spar, white, 20 mesh	$11.75
Fluorspar, f.o.b. mines, bulk, Kentucky and Illinois 85–5 per cent, all rail movement, ton	$33.00
Acid, 98 and 1 per cent, bulk, ton	$37.00
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00@$14.00
Magnesite, per ton dead-burned, f.o.b. Washington	$22.00

Mica—Base prices on sheet, North Carolina one-half trim, as posted by the Colonial Mica Corp., the Government's buying agency for obtaining strategic mica, per pound, follow: Sheet to cut minimum of 1½ × 2 in. $2.40; 2 × 2 in. $3.52; 2 × 3 in. $4.64; 3 × 3 in. $5.12; 3 × 4 in. $6.08; 3 × 5 in. $7.04; 4 × 6 in. $8.00; 6 × 8 in. $9.12; punch, 30c. Premium and discounts up to 40 percent, depending on quality and trim. Scale does not apply to non-strategic mica.

Ocher, Georgia, ton	$19.00@$22.00
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports	12c., nom.
Silica, in bags, 325 mesh, ton	$20.00@$40.00
Sulphur, Texas, mines, long ton	$16.00
Talc, f.o.b. works, ton:	
New York, double air-floated, 325 mesh	$12.00@$15.00
Vermont, extra white, 200 mesh	$9.50@$10.50
Tripoli Missouri, ton:	
40 mesh, cream colored	$14.50
200 mesh, cream colored	$26.00

IRON AND STEEL

Pig Iron, Valley furnaces, gross ton: Basic	$23.50
Steel, base prices, Pittsburgh Billets, gross ton	$34.00
Structural shapes, 100 lb	$2.10

New Books

ONE WORLD. *By Wendell L. Willkie, Simon and Schuster, New York, 1943. Pp. 86. Price $1.*

IN THIS fluently written account of his airplane trip around the world, his visits with various foreign potentates, including Stalin and Chiang Kai-shek, and the philosophy of world postwar cooperation for future peace which is the outgrowth of his experience, Mr. Willkie exhibits both eloquence and deep sincerity. The reader will find the work thoroughly readable, glowing with practical idealism, and lacking the "yes, but" weaknesses of the Atlantic Charter as a basis for a better world in the future.

THE NEW PHILOSOPHY OF PUBLIC DEBT. *By Harold G. Moulton. The Brookings Institution, Washington D. C. Pp. 93. Price $1.*

IS THE public debt a real debt, or is it something of no concern in the fiscal policy of a country? Need it ever be paid? Can it be expanded indefinitely without inflationary effect? Is an ever-expanding public debt necessary for prosperity? These are some of the questions considered and answered by Dr. Moulton. He opposes the new philosophy of public debt that has gained currency in high administrative circles of the New Deal, and which stems from the belief that the United States has achieved a mature and static economy, with no opportunity for further growth and expansion. Dr. Moulton successfully combats the new economic notions and maintains a sound viewpoint on the public debt and its influence on fiscal policy and inflation.

MICROMERITICS, THE TECHNOLOGY OF FINE PARTICLES. *By J. M. DallaValle. Pitman Publishing Co., New York, N. Y. Pp. 418. Price $8.50.*

MR. DALLA VALLE, a consulting engineer for Kruse Engineering Co., has had wide experience with, and has done considerable research work in, the field of industrial dust collection and control, both from the purely mechanical and from the public health points of view. Presented in this book is the summation of his experience in all matters connected with, as the title indicates, the technology of fine particles. Incidentally, "micromeritics" is a fine word to add to your vocabulary if, like us, you have not previously encountered it.

In addition to his own studies, Mr. DallaValle has compiled, in brief form, practically everything significant that others have done in this field. The bibliography alone occupies 39 pages.

We cannot attempt to evaluate the presentation of all matters in this volume, but we can say that in the subjects of particle-size measurement, theory of sieving, transport of particles, and industrial-dust collection, the author has done a fine job. In any event, the book is one which should be owned by anyone doing design work or research involving handling particulate material.

METALLURGICAL PROBLEMS. *By Allison Butts. McGraw-Hill Book Co., Inc., New York, N. Y. Pp. 432. Price $4.*

IN PREPARING THIS, the second, edition of his book on metallurgical problems, Professor Butts had three aims: to bring his work up to date in respect both to new fundamental data and to recent changes in practice; to incorporate changes in the book's structure dictated by his eleven years' experience in teaching with it; and to devise some new problem material to replace that which had worn thin over a decade of use. Free energy calculations are now included, for example, and the calculus is used here and there for the first time. Use of these things thus enhances the value of a book already highly regarded throughout the profession. There need be no attempt to evaluate this work. "Metallurgical Problems" is simply required reading for any metallurgical student or engineer.

MINING YEAR BOOK 1943. *Compiled and published by Walter E. Skinner, 20 Copthall Ave., London, E. C. 2, England. Pages 592. Price, post-free, 20s.6d. inland and 21s. d. abroad.*

IN ANNOUNCING the 57th annual issue of this standard reference work, the publisher states that it contains information regarding 800 companies operating in all parts of the world, together with a list of names and addresses of 888 mining engineers and mine managers and the companies with which they are connected. Other features are statistical tables showing gold production of the principal mining fields and a supplementary index containing the names of companies that have appeared in previous volumes. Skinner's is the recognized international mining year book, and the continuation if its publication during the war will be welcomed by all who are interested in the mining industry.

GENERAL METALLOGRAPHY. *By Ralph L. Dowdell, Henry S. Jerabeck, Arthur C. Forsyth, and Carrie H. Green. John Wiley & Sons, Inc., New York, N. Y. Pp. 282. Price $3.25.*

CONTAINED in this book is a vast amount of information covering almost the entire field of metals and alloys. Intended as an introductory work for beginning students in physical metallurgy, it takes up, among other things, crystal structure, alloy, constitution diagrams, cold working and plastic deformation, iron and steel, non-ferrous alloys, and corrosion. Iron and steel occupy 103 pages; non-ferrous alloys, 48 pages. This terrific compression makes necessary the handling of great quantities of facts in a rapid-fire manner which may well leave some of the beginning students breathless; but, as the authors mention, the book is also intended as a reference work, and as such, used in conjunction with lectures, it should serve its purpose.

CONTROLLING ABSENTEEISM. *L. J. Buchanan and M. B. Dahl. United States Dept. of Labor, Washington, D. C., 1943. Pp. 57. Price 10c. (Apply to Superintendent of Documents, Wash., D. C.)*

A SUMMARY, in topical form, of the causes of absenteeism and proved methods of control, which quotes from spokesmen of the companies which have had experience. This book is practical because it simply digests the experience actually obtained in the successful handling of absentee problems, rather than presenting an individual's point of view.

PUBLICATIONS

RECEIVED

Montana. **Bibliography of the Geology and Mineral Resources.** Memoir 21, State Bureau of Mines & Geology, Butte, Mont. Abstracts of 1980 articles with indexes and cross references. Pp. 350. Price $3.

Priorities and Industry. Division of Information, War Production Board, Washington, D. C. An 84-page pamphlet giving the over-all pattern of the priority system, and explaining how to obtain priorities assistance.

Association of Consulting Chemists and Chemical Engineers, Inc., 50 E. 41st St., New York, N. Y. Directory of members classified (a) alphabetically, (b) geographically, (c) by qualifications and scope of services.

Antimony and Fluorspar Deposits Near Meyers Cove, Lemhi County, Idaho. Pamphlet 62. Idaho Bureau of Mines and Geology, Moscow, Idaho. Pp. 20.

Copper Mineralization Near Salmon, Idaho. Pamphlet 60. Idaho Bureau of Mines and Geology, Moscow, Idaho. Pp. 15.

Department of Mines and Resources, Ottawa, has issued the following at the stated price:

"Snare River and Ingray Lake Map-Areas, Northwest Territories." By C. S. Lord. Geological Survey Memoir 235. Pp. 55 (map to be issued also). Price 25c.

Map 670 A, Bearberry Area, Alberta. 1 in. to the mile. One sheet.

Preliminary Map 42-7, Takla, Cassiar District, British Columbia. 1 in. to 4 miles. One sheet.

Map 696 A, Redcliff, Alberta. 1 in. to 4 miles. One sheet.

Brazil's National Department of Mineral Production, Rio de Janeiro, has issued the following bulletin (in Portuguese):

"Silicosis. Morro Velho, Minas Gerais." By Carlos Martins Teixeira, Manoel Curty, Ephrem Macedo, Octavio Barbosa. Bulletin 44. Pp. 158.

"Asbestos in Brazil." By Gabriel Mauro de Araujo Oliveira and Moacir Lisboa." Bulletin 45. Pp. 41.

"Nitrate in Piaui." By Gabriel Mauro de Araujo Oliveira. Bulletin 47. Pp. 92.

"Notes on Copper in Rio Grande do Sul." By Emilio Alves Teixeira. Bulletin 48. Pp. 38.

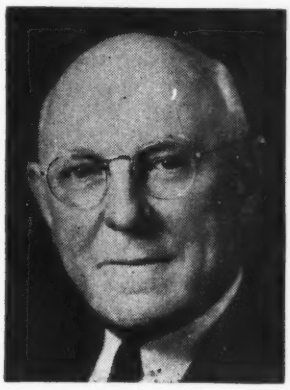
"The Copper Mine of Camaquan, Rio Grande do Sul." By Emilio Alves Teixeira. Bulletin 49. Pp. 47.

Personal Items

Lieut. Col. G. G. Blackstock was recently elected president of Steep Rock Iron Mines, Ltd., now under development in western Ontario.

Orson A. Rockwell, mining engineer, has joined the staff of Calumet & Hecla Consolidated Copper Co. at Calumet, Mich.

William P. Woodside has resigned as vice president in charge of research of Climax Molybdenum Co. Mr. Woodside has spent the past half century in the



WILLIAM P. WOODSIDE

steel industry and intends now to give the major part of his time to his farm in Oakland County, Mich. He is still retaining his interests in Park Chemical Co. and American Twist Drill Co., being chairman of the board of both companies. **Alvin J. Herzog,** a graduate of the University of Michigan, will take over Mr. Woodside's duties while still retaining his position as chief metallurgist of Climax Molybdenum. Mr. Herzog joined Climax in August, 1931, tt the inauguration of the research laboratory.

Charles ("Chick") V. Harris, metallurgist at Mulberry, Fla., for International Minerals & Chemical Corp., has been promoted to be superintendent of Peace Valley flotation plant.

Merle H. Guise has returned to San Marino, Calif., from examination of tin and manganese deposits in Arizona and New Mexico.

Dr. **C. H. Horwood,** of the Ontario Department of Mines, has been appointed .resident geologist with headquarters at Port Arthur, Ontario.

Don M. Cannon, field engineer of The Granby Consolidated Mining, Smelting & Power Co., Ltd., is in charge of the exploration of the Old Glory tungsten group near Cranbrook, B. C.

Arnold H. Miller, consulting engineer, announces the removal of his office to 140 Nassau St., New York City.

H. S. McGowan has become manager of Matachewan Consolidated Mines, Ltd., in the Temiskaming district of Matachewan, Ontario. He succeeds **G. W. Mitchell,** resigned.

Harold Andrews, formerly on the staff of Butler Brothers on the Mesabi Range at Cooley, Minn., has joined the engineering department of Inter-State Iron Co. at Virginia, Minn.

Alex Smith, formerly on the geological staff of Polaris-Taku Mining Co., Ltd., and recently engaged in mineral investigation in Alaska, is prospecting in the Stikine River area for Ventures, Ltd.

R. B. Fuller, manager of the Florida Phosphate Division of International Minerals & Chem. Corp., has been appointed an employer member of the Regional War Labor Board for the Southeastern States.

Martel H. Brett has been named acting assistant **to Ernest D. LeMay,** director of public relations of Tennessee Coal, Iron & Railway Co., Birmingham, Ala. He was previously with the *Birmingham Age-Herald.*

E. R. Tragitt, mining engineer, with the General Land Office at San Francisco, has accepted the commission of first lieutenant with the Anti-Aircraft Artillery Corps and is now established at Camp Callan, California.

William F. Hayden, consulting mining engineer of 202 Perrin Building, Webster Grove, St. Louis, Mo., has returned to his office after an extensive examination of mica deposits in Yancey, McDowell, and Rutherford counties, N. C.

Ray Swingle, native of the Comstock district and alumnus of the Mackay School of Mines at Reno, is engaged in engineering work for the International Smelting & Refining Co. at the Copper Canyon mine, in Lander County, Nev.

John Woodward, chief chemist at the Getchell mine, in Nevada, has been transferred to Gold Hill, western Utah, to conduct further tests on arsenical sulphide ore developed at that point by the Metals Reserve Co.

G. C. Lipsey during the month of May and the early part of June made a trip through northern Ontario and Quebec, studying mining methods. He visited mines in Porcupine, Kirkland Lake, Cadillac, Noranda, Beattie, Malartic, and Sudbury.

Leroy J. Harrington is the new acting manager of the American Cyanamid & Chemical Corp.'s bauxite operations in Arkansas. He has just returned from South America, where he spent 15 months in British Guiana in charge of a new bauxite plant. He succeeds the late **W. L. Powers.**

James Cole has taken Gayle Farnham's place in the assay laboratory of the Shenandoah Dives Mining Co. at Silverton, Colo., and **L. B. Steward** has been moved into the junior position. Mr. Farnham, chief assayer for the past five years, has accepted a position in the assay office of the American Smelting & Refining Co.

Ray E. Morgan, formerly of the geology department of the Wisconsin Institute of Technology, at Platteville, Wis., has accepted a position as associate teacher of geology with **Prof. F. L. Service** at Purdue University School of Chemical and Metallurgical Engineering, at Lafayette, Ind.

John Van Nostrand Dorr was on June 1 awarded the honorary degree of doctor of science by Columbia University, New York, in recognition of his contributions to metallurgical, chemical, and sanitary engineering. He has also received degrees from Rutgers University, the South Dakota School of Mines, and Michigan College of Mining and Technology.

W. W. Graff, superintendent of Negaunee, Mich., district iron operation for Cleveland-Cliffs Iron Co., has assumed responsibility, also, for the management of Cambria iron mine, at Negaunee, recently acquired by Cleveland-Cliffs from Republic Steel. **John Trosvig** has become assistant superintendent at Cambria and **John Tregonning,** mine captain.

Theodore Pilger, for the past seven years a consulting engineer with offices at 70 Wall St., New York, N. Y., has gone to Mexico City as technical adviser for Financiera Tecnica de Mexico, S.A., whose offices are at Venustiano Carranza 53, Despacho 11, Mexico, D.F. Formed to assist Mexican industry through financing and the furnishing of technical and managerial services, this

THEODORE PILGER

new company was organized by J. Lacaud y Cia, investment bankers of Mexico City, and Houston & Jolles, financial and industrial consultants of New York. In addition to his consulting work, Mr. Pilger has been associated with National City Bank of New York, the U. S. Bureau of Foreign and Domestic Commerce, Allis-Chalmers Mfg. Co., and with various mining companies in Western United States, Alaska, and Mexico. He was educated at the Colorado School of Mines and the Montana School of Mines.

James S. Thompson, executive vice president of the McGraw-Hill Book Co., is one of a group of five book publishers

in the United States who are visiting Latin America under the auspices of the Department of State and the Office of the Coordinator of Inter-American Affairs. The itinerary includes Mexico, Colombia, Peru, Chile, Argentina, and Brazil. The purpose of the trip is to facilitate exchange of publications between the United States and other American republics, and to promote educational and cultural relations. The group will report to the State Department on its return, so that the information obtained will be available to all interested persons in this country. Mr. Thompson will also represent the Society for the Promotion of Engineering Education, of which he is an officer.

OBITUARY

Francis O. Williamson, 58, mining engineer, of Alameda, Calif., died May 23 in Chicago.

Dr. George Curtis Martin, geologist and secretary of the United States Board on Geographic Names, died in Washington, D. C., on June 22 at the age of 68.

Harry W. Seamon, engineer for Metals Reserve Co. at the plant of Manganese Ore Co. at Las Vegas, Nev., died on May 14 at the property of the company.

Dr. N. F. G. Davis, of the department of geology and geography at the University of British Columbia, died on June 5 while on a field trip near Clinton, B. C. His age was 38.

Fred D. Willoughby, 72, mayor of Aspen, Colo., president of the Midnight Mining Co., and banker, died in May last. He was the founder of the Midnight Mining Co.

Earl Marshall, a long-time resident of Globe, Ariz., and for several years underground foreman at the Miami Copper Co. mine, died May 29 in the U. S. Veterans Hospital in Tucson.

Louis J. Brisbine, a native of Bisbee, Ariz., formerly employed at the Bagdad and Hillside mines in Yavapai County, was killed in a fall in a coal mine shaft at Cannonsburg, Pa., on May 30.

Joseph A. Otto, active in British Columbia mining in pioneer days and for the last 35 years prominent in mining in California, died in Los Angeles on June 17 at the age of 81.

E. H. Dresser, chief engineer and member of the board of directors of the Duluth, Missabe & Iron Range Railway, died in Duluth on May 21, 1943. Mr. Dresser was one of the most prominent men in ore railroad transportation in Minnesota.

Dr. Harry B. Meller, engineer and pioneer in smoke and fume control, head of research at Mellon Institute, and director of Industrial Hygiene Foundation of America, founded in 1935, until his resignation in September, 1942, because of failing health, died in Pittsburgh, Pa., on June 27, at the age of 65. He was educated at the University of Pennsylvania, Michigan College of Mines, and at the University of Pittsburgh, where he became an instructor and was from 1914 to 1923 dean of the school of mines. His mining studies led him into investigations into smoke control, in which he became a recognized authority.

Paul G. Leoni, president and director of the Iron & Ore Corp. of America and of William H. Miller & Co., Inc., died June 23 in New York at the age of 56. Mr. Leoni came to the United States in 1915 to establish a branch of William H. Miller & Co., Inc., a Dutch organization dealing in ores, ferro-alloys, metals, and minerals.

Donald R. Slessinger, mill superintendent for El Potosi Mining, at Chihuahua City, and **Enrique Broniman,** a company engineer, were killed when the plane in which they were traveling crashed recently in a forced landing during a thunderstorm in the mountains near El Tule, Chihuahua. Broniman, an experienced aviator, was piloting the plane. Both men were widely known in Mexican mining circles.

Frederic Hall Harvey, mining engineer of Galt, Calif., died on May 25, 1943, at the age of 74. He was an alumnus of Massachusetts Institute of Technology and had had extensive mining experience in both the United States and Mexico. He was an authority on hydraulic mining and was vice president of the California Hydraulic Mining Association. Mr. Harvey had been performing important work in the Mining Division of the War Department since his assignment to the U. S. Engineer Office on May 1, 1941, under Col. Hunter of the Corps of Engineers.

John H. Davis, former manager of the Phelps Dodge Corp.'s New Cornelia Branch, retired early in March because of ill health and went to Tucson, where he died. Mr. Davis went to work for the P. D. Corporation in 1911 immediately after his graduation from Harvard. He was on the engineering staff at Bisbee until 1918, when he was promoted to superintendent of the Bunker Hill mine, at Tombstone, where he remained until 1923. From Tombstone he went to Douglas as manager of the general offices there. He moved from Douglas to Ajo in 1940 to become manager of the New Cornelia unit. Besides his wife, Mrs. Ethel Davis, he is survived by two sons. Capt. John W. Davis, Jr., and Capt. Herbert Whitney Davis.

John C. Semple, prominent mining engineer of the Pacific Northwest, died in Spokane, Wash., on April 30, 1943. He was 52 years old. Mr. Semple began his professional career in Alaska after his graduation from Washington State College in 1914. In 1916 he returned to the United States and continued his professional work in the Coeur d'Alene region in Idaho. Following two years' service in the U. S. Army during the first World War, Mr. Semple became associated with a number of mining enterprises in Idaho, Washington, Oregon, California, and Montana. He joined the staff of the U. S. Bureau of Mines in April 1942, and until the time of his death was engaged in the exploration of the alumina-bearing clays of Idaho for that organization.

Charles Edward Stuart, consulting mining engineer prominent in his profession in England, France, Germany, and especially Russia, died on June 20, 1943, in New York at the age of 61. He was the senior member of the firm of Stuart, James & Cook, Inc., the first American engineering organization employed as mining consultants by Russia after the revolution. Recently he had been serving as a consultant to the Federal Power Commission in Washington, D. C.

A LETTER

The Totalitarian Trend

THE EDITOR:

THE EDITORIAL entitled "The Totalitarian Trend" in your May number is a striking one in that it says boldly what nearly everybody knows to be true, but from a feeling of what passes for patriotism, is afraid to say. The trend toward totalitarianism is so pronounced that it is a fair question whether there is any use opposing it. Call it rather State Socialism. It has been coming on steadily and with increasing speed in recent years. One way to note its progress is to note the increase in the expenditures of the central government:

Expenditures per Capita	
1916	$7
1920–32—postwar	30
1933–39—New Deal	60
1943—Roosevelt's estimate	800

The last figure is so extravagant that it's hard to see how it can be real. Anyway, each war spends vastly more than the preceding one, and each results in multiplying the cost of government permanently. Even in 1941, the New Dealers estimated that the national expenditures after this war will be about 22 billion, I think, say $160 per capita.

Then recollect that since 1930 the government has never lived within its income, and even before this war could hardly collect half its expenses in taxes, and the next step is to wonder what we are coming to. Some of my friends call me a pessimist, but I can't see any evidence of any likelihood of changing this trend. If we have in 25 years multiplied our government cost per capita by 25, we have increased by just that much the influence and authority of government bureaus.

Not to pursue the matter further but just to look at the figures, it seems unmistakable that the American republic that we think we are talking about came to an end in 1917 when we entered World War I. Since then we have had something else—just what, nobobdy seems to know.

If one reads Gibbon's "Decline and Fall of the Roman Empire," he cannot fail to notice that the Romans talked about their "republic" five hundred years after it had ceased to exist—i.e., they pretended it existed.

J. R. FINLAY

Redlands, Calif.

NEWS OF THE INDUSTRY

WLB Denies National Smelter Wage Raise

ON JUNE 8, the War Labor Board denied the request of the International Union of Mine, Mill, and Smelter Workers, CIO, for wage increases for employees of the National Zinc Co., whose zinc smelter is located at Bartlesville, Okla. In rejecting the request the board stated that wages had already been raised above the levels indicated by the "Little Steel" formula.

Phelps Dodge Enters Light-Metal Field

ANNOUNCEMENT has been made that the Phelps Dodge Copper Products Corp. will engage in the manufacture of aluminum and magnesium tubes, rods, and shapes, to be produced by the extrusion process. A large new plant will be built for Defense Plant Corp., to be operated under lease by Phelps Dodge. The location and actual size of the plant were not made public, in order to avoid giving useful information to the enemy.

Mineral Production Gets Gasoline Preference

ACCORDING to an announcement of the Office of Defense Transportation, mineral production will rate high on the preference list in gasoline shortage areas. The list divides essential needs into four categories: AA-1, or most critical; A-1, or very critical; A-2, or critical; and A3, or important.

No industrial uses are mentioned as "most critical." Under "very critical" are copper, zinc, mica, aluminum, and abrasive mining; and milling, smelting, and refining of the same plus the mining, milling, smelting, and refining of non-metallics. Under "critical" are mining of magnesium, iron, refractories and grain abrasives; also their milling, smelting, and refining. Listed as "important" are mining, milling, smelting, and refining of lead and other minerals and metals not classified.

RFC Spending at Rate of $164,000,000 Annually in Subsidies for Metals and Minerals

Program includes Chilean nitrate, copper-lead-zinc premium-quota plan, metal salvage operations, various domestic mineral purchases, and foreign transactions

ON JUNE 1, Secretary of Commerce Jesse Jones issued the following statements about subsidy payments by the Reconstruction Finance Corp. to the mining industry, the extracts being part of a letter to Senator Harry F. Byrd, of Virginia, covering all the subsidy activities of RFC.

"All Chilean nitrate of soda imported from July 1, 1942, to June 1, 1943, is for the account of Defense Supplies Corporation. Sale of this nitrate of soda within OPA price ceilings will result in an estimated loss of seven million dollars, of which about one-half is due to transportation costs.

Metals Reserve Co. has been paying premiums on certain excess domestic production of copper, lead, and zinc since Feb. 1, 1942. At the present rate of premiums and production this will cost approximately $53,000,000 a year, but due to efforts to further stimulate production, this cost may be increased to as much as $80,000,000 annually by the end of 1943.

Metals Reserve Co. is purchasing and selling idle and excess inventories of raw materials and partly and fully fabricated materials frozen in the hands of the holders; it is also purchasing scrap metals where the cost, including preparation, handling, refining, freight, etc., will entail substantial losses. It is estimated that in 1943 these losses will aggregate $27,000,000.

Metals Reserve Co. is encouraging the production of various and sundry metals in this country through buying them at a high price and selling them at ceiling prices. In addition to copper, lead and zinc, these include arsenic, beryllium, cadmium, chrome, cobalt, fluorspar, graphite, iron ore, kyanite, magnesium, manganese, mercury, mica, molybdenum, rutile, spodumene, talc, tantalum, tin, tungsten and vanadium. The loss on these items probably will be about $25,000,000. These materials come from one or more of the following states: Pennsylvania, Utah, Texas, Arkansas, Alaska, California, Idaho, North Carolina, Oregon, Washington, Montana, Vermont, Michigan, Arizona, Missouri, Alabama, New Jersey, Colorado, Georgia, Nevada, New Mexico, Oklahoma, South Dakota, Tennessee, Virginia, West Virginia, Wyoming, and New York.

Metals Reserve is paying abnormal transportation costs and losses on the purchase of various metals and minerals from Latin America and elsewhere abroad. The estimated loss on these for 1943 is about $25,000,000."

Leith Urges Mineral Control for Peace

A POST-WAR international policing body to enforce peace, using as a means the control of mineral resources to allow all nations industrial expansion while preventing re-armament for war, was advocated by Dr. C. K. Leith, head of the metals and minerals branch of the Office of Production Research and Development of the War Production Board, speaking at the commencement of the Graduate School of Stevens Institute of Technology on June 3. The college conferred on Dr. Leith the honorary degree of Doctor of Science.

"In spite of all efforts to neutralize the inequalities among nations, international friction over mineral raw materials has steadily grown, and if we accept the fact that world industry must and will grow in the future and that mineral supplies are becoming ever more essential to preparation for war, the outlook now is for more and more international trouble arising from this source. The problem reached the explosive stage in World War I and again in World War II, and unless something is done about it, more explosions seem inevitable in the future.

"With this situation before us, naturally a considerable amount of attention is now being given to the mineral question in relation to post-war reconstruction. Many plans have been proposed by many groups.

"The Atlantic Charter promises to meet the problem by insuring equal access to raw materials by all nations, victors and vanquished, and as a means to this end, it proposes a removal of trade barriers. Our Government has also proposed the extension of reciprocal trade treaties to promote international trade and facilitate the flow of raw materials. In general, these proposals, and others of this kind that might be cited, are in the nature of an appeal to sweet reason.

"A quite different proposal is one based on the failure to settle the problem in the past by political measures based on negotiation between nations in mutual good faith. It is that the international flow of minerals be controlled by a group of nations which may be formed at the end of the war for the purpose not only of equitable distribution for legitimate needs but of policing the world and keeping peace. If the Allies win, they will have control of much the larger part of the world's mineral resources, together with control of transportation. The English-speaking people alone control three-quarters of the world's minerals politically and commercially. The proposal is that the United

Nations would withhold from the Axis powers or any other recalcitrant nations the supplies necessary to build up armaments to a scale which would menace the peace of the world, while at the same time allowing all nations enough for peace-time needs. It is a proposal to control armaments at the source of the raw materials necessary for their manufacture.

"One essential element of mineral control will be the accumulation of stockpiles of strategic minerals needed by the policing powers which will permit immediate expansion of armament necessary to stop quickly any aggressive action of recalcitrant nations. It does not do to wait. The present war has shown dramatically what can be accomplished by sudden attack by nations which have accumulated the necessary stockpiles for immediate conversion into armament, as contrasted with the United Nations long struggle to bring their weight of metal to bear. Only now after three years of concentrated effort are we prepared to strike.

"The negative side of the stockpile program, includes the prevention of stockpile accumulation by Axis nations or by any other nations which may plan for future aggression.

"Another part of the stockpile program should include the continuance of technological investigations which are proving so vital in the present war. The knowledge of how to use the raw materials is fully as important a consideration as accumulation of the materials themselves. It should be carried at least far enough to complete our knowledge of the possibilities of use of all the raw materials potentially available to us in the United States. The Germans again showed how important this is when they started their technological preparation at the same time they started their accumulation of raw materials.

"Many arguments pro and con might be brought forward for either of these two main kinds of procedure to lessen the international friction caused by minerals—the one by mutual agreement of all nations, the other by force. My own confirmed belief is that the solution lies in the firm control of raw materials by an international policing body for the enforcement of peace. This is a position I have come to reluctantly in recent years, after exploring and reviewing the many efforts to meet the problem through mutual international understanding. Whatever the ethical merits of the proposal, I am forced to the conclusion that ours is still the kind of a world which requires the enforcement of peace, and that mineral resources offer a potentially powerful implement of enforcement."

WPB Canvasses Gold Mines for Mercury

ON JUNE 9 the War Production Board sent requests to operators of all domestic gold mines, whether active or shut down, to report inventories of mercury on hand. The purpose of this action is to take steps to put idle stocks of mercury into the hands of users necessary to the war effort. Holders of idle stocks are urged to sell them to authorized dealers or users; otherwise WPB may step in and requisition the mercury.

Important Zinc Orebody Found in Bolivia

ACCORDING to the *Foreign Commerce Weekly*, published by the Department of Commerce, the complex ores of silver, lead, and zinc found in Bolivian mines, particularly in the southern region, offer possibilities for important zinc production.

The Compañía Huanchaca is one of the most important producers of concentrates of these metals and is virtually the only zinc producer in Bolivia. It is operated by Compañía Hochschild, owners of the recently prospected and developed Matilde mine near Lake Titicaca. The Matilde mine reportedly contains 2,000,000 tons of proved ore containing 20 percent zinc, 24 percent lead, 1.6 oz. of silver per ton, and traces of copper.

Titanium Producers Are Indicted

ON JUNE 28 a federal grand jury indicted the National Lead Co., a subsidiary, the Titan Co., and E. I. du Pont de Nemours & Co. on charges of participating in international cartel activities to control titanium prices and production and to allocate markets. Charges were brought by the anti-trust division of the Department of Justice.

F. W. Rockwell, president of National Lead, stated that the practices complained of were regarded as legal and proper at the time they were inaugurated.

"National Lead's co-operation with companies in Norway, Great Britain, Germany, France, Canada and Japan," Rockwell said, "was for the purpose of developing the titanium industry and its techniques, and at all times before and during the war the company and its competitors had filled all government requirements."

Rockwell said if American business was to have any place in world markets after the war "it must have now a directive from government and the people of the United States on how they want international business conducted. . . . As a result of the badgering which American industry is now undergoing at the hands of agencies of government, business has no alternative but to become completely anti-international and firmly isolationist in sheer self-protection."

Steel Company Will Mine Pegmatite

BARIUM STAINLESS STEEL CORP., of Canton, Ohio, has announced that it has acquired 24 mining claims in Pennington County, S. D. for the production of tin, tungsten, mica, and beryllium, and will proceed with mining operations. These claims are in the Black Hills region of the State where pegmatites carrying these mineral substances have been mined for many years.

Cable Earmarked for Mining Industry

THE COMPANIES LISTED BELOW are directed by WPB to manufacture cable exclusively for the mining industry in the sizes and types listed. This cable can be obtained only by holders of P-56 serial numbers within the quotas allotted to them, and should be procured through regular suppliers.

The standard production lengths of mining cables are 1000 ft. and 1200 ft. In order to obtain maximum production without unnecessary scrap, mines should order cables in lengths that are easily divisible into the above standards. These would be 250 ft., 300 ft., 333⅓ ft., 400 ft., 500 ft., and 600 ft. Mines that must have lengths other than these should order the nearest larger even division and save the extra for splicing purposes. This procedure will make full use of the cable that is being produced under this directive.

American Steel & Wire Co.	#2 and #4 single-cond. locomotive cable
Anaconda Wire & Cable Co.	#1, #2, and #4 single-cond. locomotive cable #2 and #6 2-cond. concentric cable #4 and #6 parallel cable
General Cable Corp.	#2 single-cord. locomotive cable #4 2-cond. concentric cable
General Electric Co.	#2 and #4 single-cond. locomotive cable #2 parallel cable #2 2-cond. concentric cable
Okonite Co. (Hazard Div.)	#2 and #4 single-cond. locomotive cable #2 parallel cable
U. S. Rubber Co.	#2 and #4 single-cond. locomotive cable #2 and #4 parallel cable #2 2-cond. concentric cable
Rome Cable Co.	#2, #4 and #6 single-cond. locomotive cable #2 2-cond. concentric cable #4 2-cond. concentric cable #2 parallel cable
John A. Roebling & Sons	#2 and #4 single-cond. locomotive cable #2 and #4 parallel cable #2 2-cond. concentric cable
Simplex Wire & Cable Co.	#1 #2 and #4 single-cond. locomotive cable #2, #4, and #6 parallel cable #2 2-cond. concentric cable

Note: No #3 cable is manufactured in either single or double conductor.

None of the manufacturers are precluded from manufacturing any cable larger than #1 or smaller than #6 if they have available plant facilities over and above those necessary for the making of cable as directed above.

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2. Keep the top of the battery and battery container clean and dry at all times. This will assure maximum protection of the inner parts.
3. Keep the battery fully charged—but avoid excessive over-charge. A storage battery will last longer when charged at its proper voltage.
4. Record water additions, voltage, and gravity readings. Don't trust your memory. Write down a complete record of your battery's life history. Compare readings.

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Buy to Last and *Save to Win* means plenty at home and on our fighting fronts, too. It's a big step toward Victory . . . and pays dividends in extra use of equipment.

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CALIFORNIA

Lava Cap Suspends Banner and Central

Amador Consolidated being rehabilitated —New chrome mill near Auburn—Quartz crystal properties under development

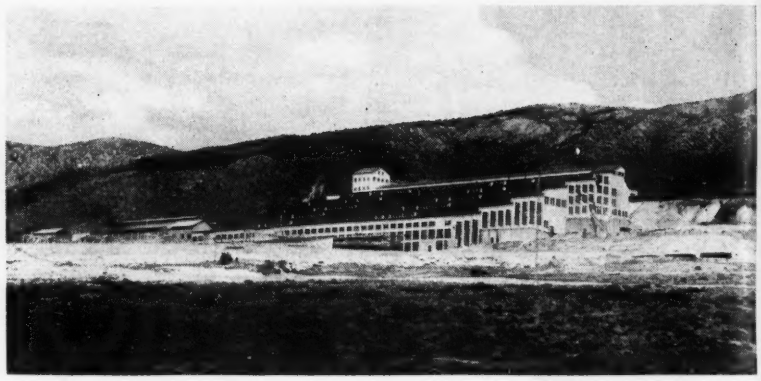
▶ Complying with a closing order from WPB, Lava Cap Gold Mining Corp., the last major gold producer operating in California, suspended operations on June 7 at its Banner and Central properties, near Nevada City. Until the shutdown, the company milled about 350 tons of ore a day and employed more than 200 men, the concentrates and fluxing material produced being shipped to the Selby smelter. The mines will be permitted to fill with water rather than involve the expense of maintaining them in working condition. Crews are at work removing pump, motors, and other equipment installed underground. Activities are being transferred to the Keystone copper mine, in Calaveras County, acquired recently by the company, with current production and milling facilities to be increased shortly. The company is also interested in a lead-zinc-copper property in the Nevada City area and a manganese mine in Siskiyou County, and development work is planned. Otto E. Schiffner, vice president and general manager, directs all company operations.

▶ Work is proceeding according to schedule at the Napoleon copper mine, near Copperopolis, Calaveras County, reopened and equipped last year by Mountain Copper Co. Ltd., William F. Kett, general manager. Operations at the Napoleon are directed by J. M. Basham, general superintendent. The company also owns the Iron Mountain and Hornet copper mines, in Shasta County, and a smelter near Martinez.

▶ Rehabilitation work is reported in progress at the Amador Consolidated gold-tungsten claims a short distance south of Grass Valley, Nevada County, leased recently by E. S. Armstrong from D. W. Johnson, of Sacramento, and associates. The 250-ft. shaft is being retimbered, and a small surface plant is in course of construction. Frank Roberts, superintendent, is in charge.

▶ Mining and milling equipment is scheduled to be installed soon at the Jessiebell Extension copper mine, about 14 miles east of Madera, Madera County, and operated under lease by the Sisson Gold Mining Co., of Los Angeles. Preliminary development, started after completion of dewatering operations, has opened up an orebody with good copper values. Most of this work was done under an RFC loan. Elmer L. Sisson, manager, directs operations at the mine.

▶ Development work is in progress at the Helen quicksilver mine, in Lake County, following release of a loan on the part of RFC to Anglo American Mining Corp., lessee of the property. Prior to the lease arrangement completed last year between the company and the H. W. Gould interests, of San Francisco, the owner, the mine was worked for several years under lease by Alan Fleishhaker. H. W. Klipstein is executive vice president.



Flotation concentrator of Nevada Consolidated Copper Corp., Kennecott affiliate at McGill, Nev., treating up to 22,000 tons per day

▶ Milling facilities to treat chrome ore mined from properties in the area lying between the North and South Forks of the American River, including the Darrington chrome property, are being installed at the plant of Auburn Chemical Lime Co., near Auburn, Placer County, acquired recently by J. J. Taylor of San Francisco, and associates. The company owns and has under lease several chrome mines in the district and has carried on development work for some time. At the Darrington property a 75-ft. shaft has been sunk, and ore of good milling grade developed. The part of the plant producing burnt lime remains undisturbed though idle.

▶ Two quartz crystal mines are under development in Calaveras County. R. P. M. Davis has installed machinery and is exploring new ground at the Calaveras mine, and a small production of crystals is reported from the Rough Diamond mine, rehabilitated recently under the direction of S. Menchini, superintendent. Both properties are in the Chili Gulch area.

▶ Early in June Hoefling Brothers shipped the first 50-ton car of zinc concentrates from Pulga station in Feather River Canyon. A similar shipment is scheduled to go out every ten days or two weeks. This production comes from the Big Bend mine, five miles by road from the Surcease mill, where the ore is crushed and concentrated. The Surcease mill has been adapted from gold recovery to zinc requirements, and a loading station for concentrates built at Pulga, on the Western Pacific Railroad, 17 miles away. The Big Bend property has been under exploration and development since last October. A road has now been completed and the mine shaft is down about 200 ft. with ore being taken from the upper level as development proceeds deeper. At the present about 25 tons per day are being mined and milled with a crew of 18 men. If mine developments are favorable, capacity can readily be increased, as the Surcease mill is capable of handling 100 tons of this type of ore daily. W. E. Messner is superintendent of operations, assisted by Jack Lawton, mine foreman and John Gustafson, mill foreman.

NEVADA

Produce Iron Ore For Ship Ballast

Hidden Treasure claims under development—Mina cinnabar mine resumes operation — Scheelite deposits found near Tonopah

▶ Demand at Pacific Coast ports for iron ore of high specific gravity, for use as ballast in warships and merchant vessels, has resulted in investigation and sampling of several deposits in Nevada, from two of which surface ore is being shipped. Navy specifications were said to require a minimum 65 percent iron content, or specific gravity of 4.5 and solid weight of 220 lb. per cubic foot. The ore is crushed to minus 3 in., shipped in bulk, and is mixed with a low-grade cement binder to form blocks. The Strategic Minerals, Inc., Harry E. Springer, of Hawthorne, president, is shipping from its crusher plant on the old Minnesota iron mine near Buckskin, Lyon County, where more diamond drilling will be undertaken with the company's Mitchell drill, under the direction of Fred O. Gilbert, of Luning, manager.

▶ Mine equipment and camp facilities have been provided at the Hidden Treasure lead-zinc-silver claims in the Central district, northern Pershing County, by Daniel Whatley, oil operator of Houston, Tex., in association with his son, Dan E. Whatley, of Evansville, Ill. Winnemucca is the mail point, with shipping ramp 5 miles distant at Pronto on the Western Pacific railroad.

▶ The American Smelting & Refining Co. has filed its charter with the Secretary of State of Nevada, paying a fee of $1,750, in order to qualify as a foreign corporation to transact business in the State. The purpose is to undertake development work on the old Cleveland lead-silver mine, in the Delno district, 12 miles northwest of Montello, in eastern Elko County. George B. Thatcher, Reno attorney, represents the A.S.&R. interests in Nevada.

▶ Production of quicksilver has been resumed by the Mina Mercury Co. from

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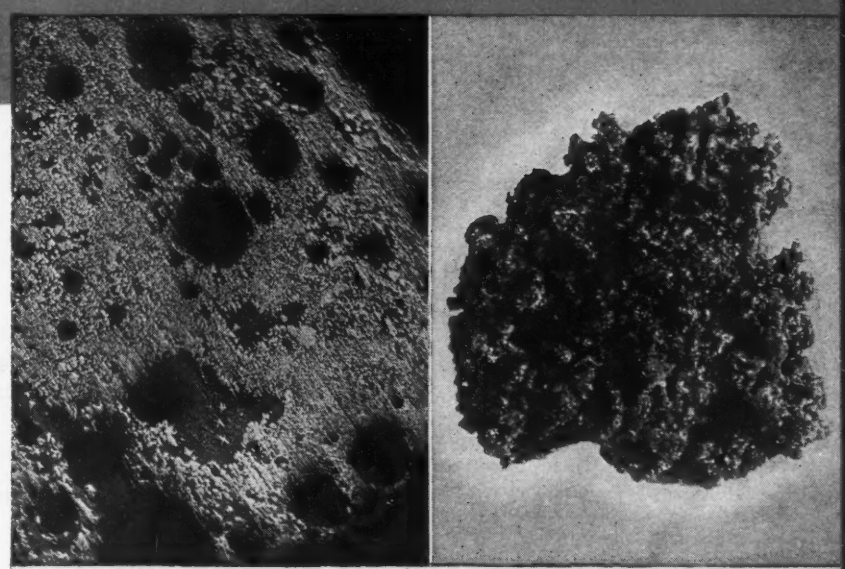
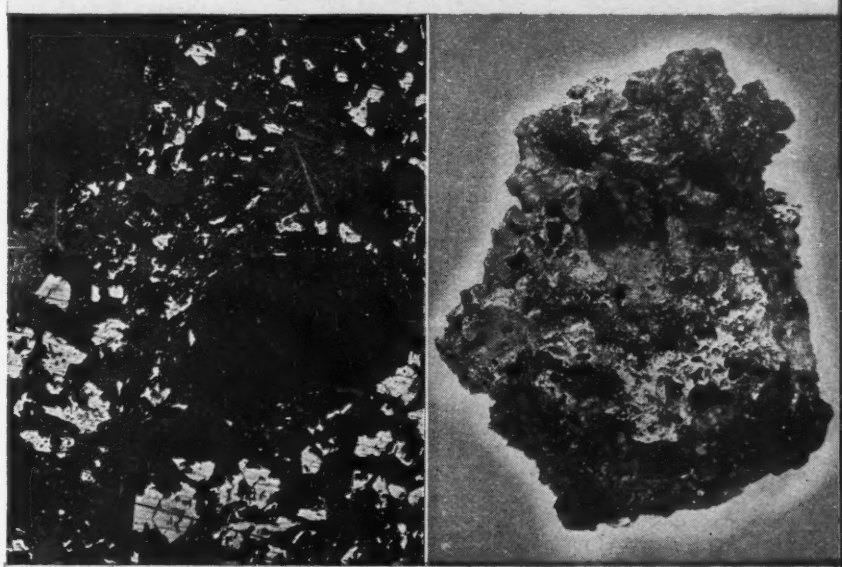


IDEAL BLAST-FURNACE SINTER. *Microscopic cross section of sinter (100 times enlarged) shows uniform cell structure which provides maximum surface for gas contact.*



POOR BLAST-FURNACE SINTER. *Note density and uneven cell structure providing poor gas contact.*

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▶NEVADA

its cinnabar mines and furnace plant in the Pilot Range, eastern Mineral County. L. B. Spencer, of Mina, is manager. The plant had been closed down for several months.

▶ Ore shipments in late months from Tonopah and tributary districts have ranged from 26 to 30 carloads monthly, around half of which is zinc-lead ore from the Tybo mine, 60 miles east of Tonopah, operated by the Hall Bros. Co., of East Ely, under lease from the Treadwell-Yukon Co., Ltd. Lessees of the Tonopah Mining Co., of Nevada, average 12 cars, and other shippers include the Tonopah Divide mine and lessees at Goldfield.

▶ A new incline shaft is being sunk by the Nevada Metals & Development Co., L. G. Blakemore, of Reno, president and manager, on ground formerly embraced in the Commonwealth mine in the Galena district, 13 miles south of Reno. The mine, one of the oldest in Nevada, has been worked at long intervals and has produced many smelter shipments from large ore bodies.

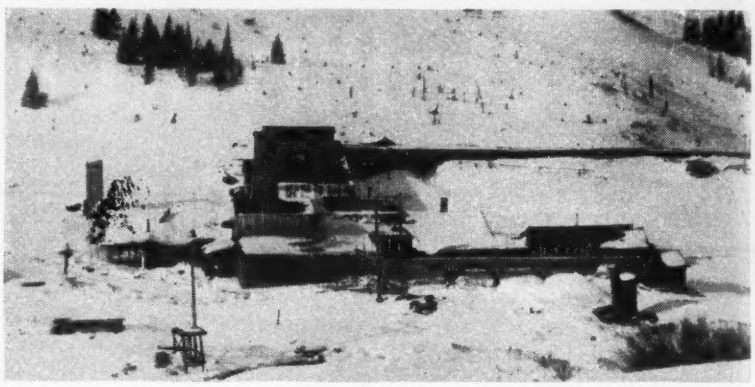
▶ Tests conducted at the U. S. Bureau of Mines station in Reno have established the presence of zinkenite in substantial quantity in the Red Bird cinnabar mine of the Harold's Club Mining Co., now producing over three flasks of mercury per day in the Relief district of southern Pershing County. This ore is stockpiled at the mine for future disposal when and if lead and antimony prices warrant.

▶ Consolidated Coppermines Corp. reports a net deficit of $31,000.58, before depletion, for the first quarter of 1943, against net income of $111,146.71 for the corresponding period last year. John A. Payne, president, explains that the drop in production and earnings was due to the acute shortage of manpower. He announces that a revised production quota has been accorded the company, effective as of March 1 of this year.

▶ Scheelite deposits, said to be of the first importance in grade and volume, have been found in the Monte Cristo Range 30 miles northwest of Tonopah in Nye County by O. D. Welsch, mining engineer and director of the Tonopah mining school, now closed for the duration. A number of claims have been located.

▶ Arsenious oxide, produced at the rate of 10 to 25 tons per day from furnace fume by the Getchell Mine, Inc., in the Potosi district, Humboldt County, is shipped to receiving depots of federal agencies, according to a report by Metals Reserve employees. Arsenic contained in the sulphide gold ore was wasted until late in 1941, when the company provided a Cottrell electric precipitator unit.

▶ The Dayton Dredging Co., which last October closed down its 10,000-cu.yd. dragline and washing plant at Dayton, Lyon County, is reported to have taken a lease on placer ground of the Nevada Porphyry Gold Mines, Inc., at Round Mountain, Nye County. The gravel deposits were worked, with large production of gold, during a number of years, by ground-sluicing and hydraulic methods, by the Round Mountain Mining Co., headed by L. D. Gordon, now directing the RFC mine loan division in Nevada.



Wilfley mine and mill, at Kokomo, Colo. The company ships zinc, lead, iron, and copper concentrates

COLORADO

Many Old Producers Being Rehabilitated

Pennsylvania mine, at Montezuma, is leased—Camp Bird operating on 100-ton schedule—RFC loan to reopen Black Bear mine, near Telluride

▶ Governor Vivian has reappointed two members of the board of directors of the State Metal Mining Fund, and named one new member for the terms expiring March 31, 1949. Harry A. Brown, of Aspen, and Alex McLellan, of Boulder, were the members reappointed, and John Harvey, of Leadville, was named to succeed Lawrence A. Brown, of Leadville.

▶ The road to the Stevens property, in the West Argentine district, Georgetown, has been cleared of snow and ice by county equipment, and Harding and George, who had done considerable work in retimbering the ninth and fourteenth levels before the road became impassable, are ready to resume work on both the stoped and new ground above the ninth level. A portable compressor has been installed at the property. In the same district, O. Barlow Wilmarth is breaking ore in the drift started 100 ft. above the Grizzly tunnel level, which ore contains a high percentage of zinc. He plans to make a shipment of zinc ore this month.

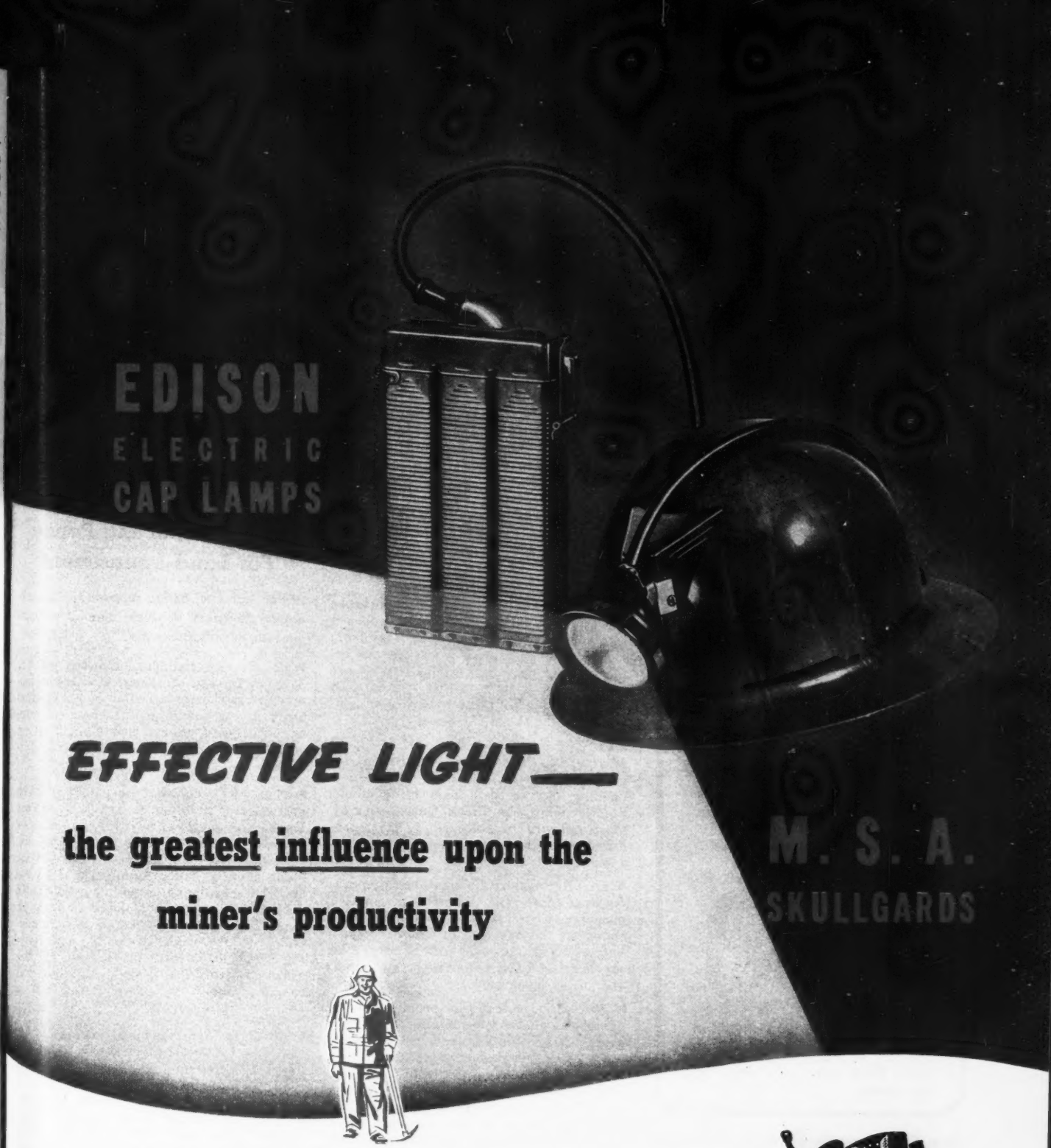
▶ In the Montezuma zinc-lead area 80 to 100 miners are working, preparing for production this summer. The Marlin property, operated by Robert C. Druesdow, of Omaha, Neb., is getting ready to go into production. Snow has been cleaned from the road, so that supplies and provisions can be taken into the mine. The mill is in good condition, and mill ore on the No. 3 level is opened for 125 ft., with the ore chutes and manways every 30 ft. The mine contains milling ore, and ore high enough in grade for direct shipping is expected to be opened up in the near future. On one vein in this property a good streak of zinc, 4 to 5 ft. wide, has been opened and it can be easily milled.

▶ The Old Precious Metals Group, also known as the Silver Crown, about seven miles northwest of Silverton; and on the Ouray-Silverton highway, is being operated by Charles C. Goulding. He has an RFC preliminary loan and plans to have the property ready for inspection by June. This is a zinc-lead mine that was extensively developed in the early 1900's and then abandoned in 1920, the original owners having developed the vein seeking silver. Goulding, having cleaned up the property, is making preparations to get air back into the workings so that a complete examination can be made to determine the magnitude of the ore that now shows up well in the workings that are accessible.

▶ William Lonergan, of Silverton, operating the Cincinnati mine, on Blair Mountain, has opened up a 125-ft. orebody carrying milling ore at a depth of 600 ft. Values in copper, lead, and gold are being produced from this mine under lease.

▶ An air compressor has been installed at the Diamond tunnel level of the Dives-Pelican property, at Georgetown, and a cross-cut is being driven. The property is being reopened under Parks B. Van Dolah for the Golden Cycle Corp. The power line to the tunnel has been completed by the Public Service Co. Also, two truck loads of mine cars have been delivered to the mine.

▶ Joe M. Bradley, general manager of the Highland Mary Mines, Inc., Silverton, is working more than a dozen men getting the property ready for early production. Supplies are being transported to the mine and mill to start operations simultaneously. Charles A. Larson again came up from Durango to take charge of the office, and he has been helping Joe M. Bradley, rushing the work preparatory to production. The office has been set up in the Denson Block. The home office is in Kansas City, Mo. This property has been an



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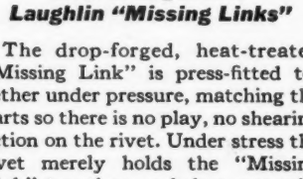

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▶The Westcliffe Mining Co. has been mining vermiculite near Querida. Other companies and individuals are considering development on properties at Querida and on the flats north of the town.

▶Carl Peterson has leased the Old Pennsylvania mine, near Montezuma, to Ray and Will Swanson and Fremont Goodwine, on the split-check system. Assays from ore on D and E levels showed as high as 126 to 284 oz. silver, 20 percent lead, and 1 percent copper. Besides this high-grade ore they estimate some 250,000 tons of good milling ore broken and stored in the stopes. They are opening a road from the mine to the mill, and Oscar Fisher, mill superintendent, will operate the Plymouth mill on this ore. The Pennsylvania mine is credited with the largest production in the Shoe Basin district.

▶The Rawley property, in Saguache County near Bonanza, is being reopened by John E. Costello and associates from Denver. Underground workings are being cleaned out and retimbered and ore left by earlier operators is being taken out. The ore contains a high zinc content.

▶Henry Johnson and A. J. Betz, of Marble, have leased the Catalpa mine, on Crystal River, and have several men opening old stopes. This mine, about a mile below the Black Queen, and almost unheard of since early days, produced considerable ore over fifty years ago.

▶Ed. Heckendorf is making preparations to open the Edgar mine, which property is reached through the Big Five tunnel at the west end of Idaho Springs. Some 3,000 ft. of wire will be strung in the tunnel to operate the hoist, pump, and other machinery.

▶The San Juan region promises to be one of the most active mining territories in the State this summer. Snow is being cleared from the roads leading to old mines that have been idle for years, which, because of the higher prices, again become commercial projects. Development work undertaken last summer has put many of the mines in condition to start shipments. The Camp Bird mine, about seven miles out of Ouray, operated by the King Lease, with Frank Busch as mill superintendent, is producing ore on a 100-ton schedule. Using only about a third of the mill space, ores are processed partly by flotation and partly by amalgamation. Ores recovered from the workings of the mine include zinc, copper, iron, lead, and some gold. This old property has many miles of tunnels and stopes, the longest being the main transportation tunnel, which cuts a direct line from the portal straight to the heart of the mine for 11,000 ft. The mine and mill now employ about 70 men. Originally a gold producer, recently the mine has been producing principally zinc, lead, and copper.

▶A ten-year lease and option on 400 acres of mineral land adjacent to the Urad Molybdenum property on Red Mountain 10 miles west of Empire has been granted by Alice C. Wilson Zehr, Sam H. Weber, and Edward Heckendorf, to the Molybdenum Corp. of America, for $100,000. A minimum royalty of $5,000 a year is to be paid by the Molybdenum Corp.

▶An RFC loan of $1,300,000 has been granted by the RFC to the Idarado Mining Co. to finance the reopening of the Black Bear mines, near Telluride. According to company officials a 6,300-ft. tunnel will be driven to make an estimated 390,000 tons of zinc-lead-copper ore available.

ARIZONA

New Prospecting Policy For Land Department

Antler mine is being reopened—Consolidated Feldspar doubles capacity—Dixie mine to be rehabilitated

▶Dr. T. G. Chapman, director of the Arizona Bureau of Mines, at Tucson has announced the installation of an optical beam and a polarizer for the preliminary testing of quartz crystals. Testing service is available to residents of Arizona.

▶The total amount of RFC loans granted in Arizona is $841,000. These loans are distributed over 12 of the State's 14 counties, and among 110 different mines. The greatest number of loans have been made in Yavapai County, where 32 loans, amounting to $299,000, were made. In Mohave County 17 loans, aggregating $138,500, were made. Gila County, with 15 loans, aggregating $135,000, is third on the list. In the other counties loans are less than ten to the county, excepting Pima, where 14 loans were made.

▶An access road has been approved by the War Production Board for the benefit of the Rosemont lease, at the King in Exile mine in Pima County. This is a 1½ mile continuation of the Helvetia access road, which was recently completed. The cost of the new road will be $10,500. Construction has already begun.

▶The Arizona Land Department has announced the establishment of regulations governing prospecting on school or institutional lands. Prospecting for a greater period than five days requires a permit. Permits for 90 days will be issued to citizens of the United States and provide that upon the discovery of valuable minerals notices of location must be filed with the customary affidavit of discovery. In the event of nondiscovery within the 90-day period, the permitee, if proper showings can be made to justify further prospecting, may be granted another 90 days at the discretion of the commissioner. Only one such extension of 90 days will be granted for a given area. Under the terms of the permit, the applicant agrees to deliver possession of the land to the lessor at

the expiration of the permit. He also must agree not to interfere with or prevent the holder of any agricultural or grazing lease from full and free use and occupancy of surface of such lands, and of any water located thereon, except the specific parts of such land as the permitee is working. These regulations apply to approximately 10,500,000 acres of school and institutional lands in the State, but do not to public domain under the Taylor Grazing Act.

▶The old Antler mine, in the Cedar Valley mining district, some 12 miles east of Yucca, has been taken over by Vukoye Brothers, of Kingman. The mine was located and explored more than 60 years ago, and except for the shipment of a few cars of ore from the dumps during the first World War, the property has been idle for more than 40 years. The new operators propose to unwater and clean out old drifts.

▶George W. Wright, of Globe, leasing the McCormick lead property from the Miami Copper Co., is shipping to the A.S.&R. plant at El Paso, Tex. Production is at the rate of 12 tons daily. Deeper development is in progress.

▶Cleve Van Dyke, Miami, announces that the first two cars of ore from the recently rehabilitated Van Dyke Copper Co. mine have been shipped to the International smelter at Miami. The property has been rehabilitated by means of Defense Plant Corp. funds. The mine is working three shifts daily.

▶William Andrews, of Globe, has shipped another car of high-grade, iron-free asbestos from the Pinetop mine, 37 miles northeast of Globe. In the car were small lots from properties owned by Arthur Enders, Frank Lunn, Roger Kyle, of Globe, and Earle Pierce, of Young, and John E. Bacon, of Miami.

▶The Manzanita mine, in the Chloride district, Mohave County, owned by Minnesota-Conner Inc., Camden, N. J., is under lease to Russell E. Lord, of Chloride, who is shipping silver-lead ore to Salt Lake City.

▶The capacity of the Consolidated Feldspar Corp. plant at Kingman has been doubled by the addition of crushing and screening equipment. This will enable the company to produce 14 carloads per month, in addition to small lots shipped by truck. Ed Boone, general manager of the company's operations in the United States and Canada, is headquartered in Spruce Pine, N. C. General superintendent of the Kingman plant is C. F. Hendrix.

▶The old Dixie mine, near Fort McDowell, in Maricopa County, is to be reopened by C. Ray Weirs, of Phoenix. The original shaft, 245 ft. deep, will be rehabilitated and lateral development will follow. The property has produced copper, gold, silver, and antimony.

▶W. M. Hauser, engineer for the Universal Mining & Smelting Co. of Globe, reports that production has begun from the Columbia mine, in the Dripping Springs district, in Gila County. After a preliminary loan from the RFC, the company was granted another loan for the purpose of putting the mine in production. The ore carries copper.

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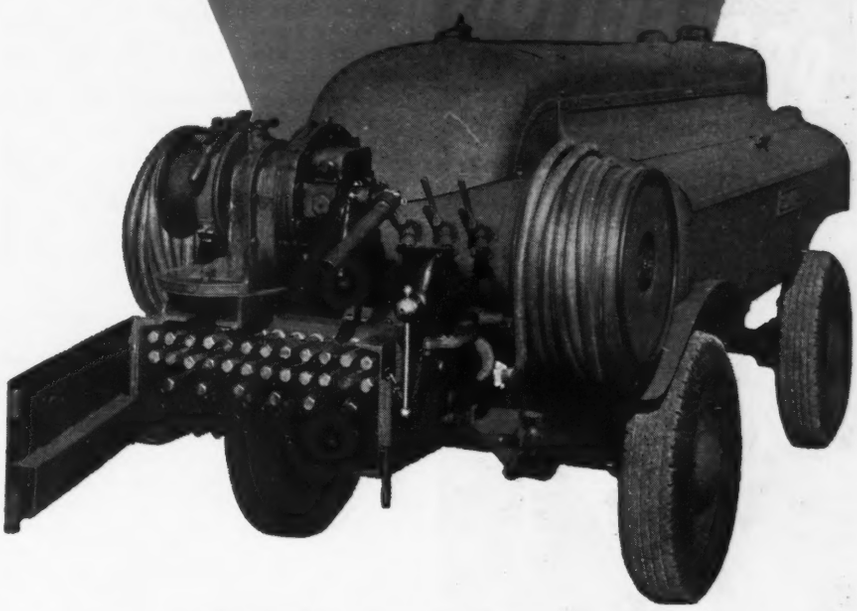

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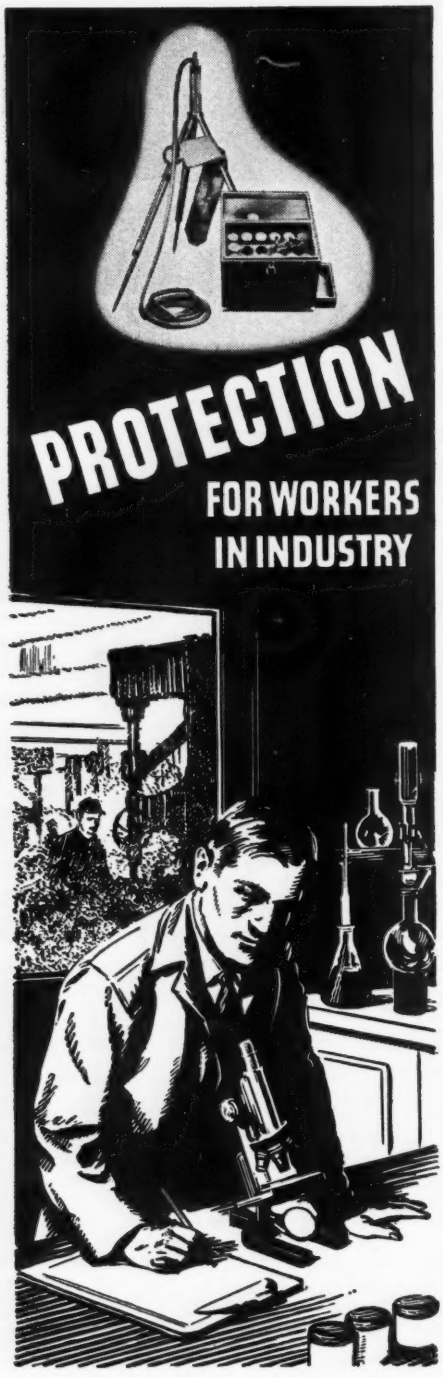

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UTAH

Court Decision Will Aid Bloc Leasing

NLRB holds election among Utah Copper employees—Progress made on renewing underground labor contract—Mine valuations are increased

▶ All mines in Utah have been assessed by the State Tax Commission for 1943 property tax purposes at $133,176,403, compared with $118,658,179 in 1942. Metal mine occupation taxes were fixed at $830,522.42, as compared with $789,939.24 for 1942.

▶ As the result of an order disestablishing the Independent Union of Mine Workers by the National Labor Relations Board, 1,700 employees of the Utah Copper Co. began voting on June 17 to select a collective bargaining agency or to reject organizations seeking to represent workers. The independent group has appealed to the Tenth District Court, of Denver, seeking a review of the case resulting in disestablishment.

▶ Negotiations for a new contract between operators and the International Union of Mine, Mill and Smelter Workers for underground metal miners in Utah are making favorable progress at the State Capitol. Eldred M. Royle, chairman of the State Labor Relations Board, is presiding as chairman, and Stephen D. Halligan, of Denver, representing the U. S. Department of Labor, is acting as mediator. Agreement has been reached on holidays, overtime, seniority, vacations, handling of grievances, and local negotiations. The request for pay increases for the proposed contract, effective June 30, 1943, which range from 80c. to $1.30 a day and would increase daily wages for miners to $8.25 and $8.75, compared with the present scale of $6.95 and $7.45, will be submitted to the War Labor Board.

▶ Judge Tillman D. Johnson, of the U. S. District Court at Salt Lake City, has ruled in the case of the Combined Metals Reduction Co., to recover $18,655.79 from the federal government paid for old-age security and unemployment compensation, that the taxes were wrongfully collected, the employees held the status of lessees or independent contractors and were not employees of the company. This decision, if accepted by governmental agencies, will remove the last remaining barrier, it is thought, to mine leasing in Utah.

▶ Tungsten ore accumulated at Salt Lake City by the U. S. Vanadium Corp. for the Metals Reserve Co., is being shipped to the Segerstrom mill, near Milford, for concentration. The Segerstrom mill has been treating scheelite from the Old Hickory mine for nearly a year. The Salt Lake City plant treats middlings and concentrate, but no crude ore.

▶ Unwatering of the Ontario mine, at Park City, to the 2,000-ft. level, 500 ft. below the No. 2 drain tunnel, is progressing rapidly below the 1,700-ft. level. Production at the Chief mine, Eureka, has been increased as the result of unwatering.

▶ Premium payments by the federal government to Utah metal mines will not be included as part of the net proceeds in estimating property tax valuations by the Utah State Tax Commission, announced Chairman J. Lambert Gibson. The Utah law provides that only money received from sales of ore can be considered in setting net proceeds.

▶ National Tunnel and Mines Co. corrects the statement concerning the company's annual report in the June issue of E.&M.J., as follows: Gross income amounted to $320,882.04 and direct cost of sales, principally operating expenses, amounted to $912,067.33. The net loss for the year, without deduction for depletion, was $632,479.39, due to extra development expense, mine rehabilitation, increased wages, and shortage of manpower.

IDAHO

New Polaris Orebody Is Deemed Important

Mica is discovered near Avon—Snowstorm mine is reopened—Federal will mill old dumps of Morning mine

▶ Disclosure of a body of lead-silver ore in the Chester vein of the Polaris Mining Co., adjoining the Sunshine mine, in the Coeur d'Alenes, is looked upon by local mining men as one of the most important discoveries in that area in recent years. The ore was found in a crosscut from the 2,700 level of the Sunshine mine. A 70-in. streak of high-grade galena was shown when the vein was first reached. Drifting for 75 ft. has disclosed a full face of mill-run ore carrying commercial values in lead and silver. Development work is carried on by Sunshine on a contract basis, the ore showing being about 1,000 ft. below the deepest workings of the Polaris mine. The Hecla Mining Co. controls of the Polaris-Chester holdings. In the upper levels the Chester vein did not reveal commercial ore but did show a strong, wide fissure.

▶ Bradley Mining Co., operating the Yellow Pine mine, at Stibnite, is credited with having uncovered the largest antimony mine in the United States and is now furnishing the bulk of the antimony required for war purposes. In addition to the antimony the Stibnite district furnishes a large tonnage of tungsten.

▶ An RFC loan of $5,000 has been granted David E. Bell, of Mackay, for the prospect development of the Champion lead-zinc group in Custer County. The owners have recently shipped a car of ore to the Utah smelters.

▶ Mica in commercial quantities and grade has been discovered at Avon,

Latah County, according to David Keppel, New York geologist. The property is about 36 miles from Moscow, Idaho, seat of the Idaho State Bureau of Mines. Mr. Keppel is geologist for the Colonial Mica Corp., agent for Metals Reserve. The new disclosure will be given immediate study and development to determine its extent.

▶George Wikstrom, of Vancouver, Wash., veteran mining man of the Coast, is investigating the Numbers placer property near McCall for possible cinnabar deposits. Samples of the ore have been found in considerable quantity in placer gold operations, and an effort will be made to locate the source of the deposit.

▶The Snowstorm mine, near Mullan, presumably worked out and abandoned 30 years ago, is again the scene of operations. The property was sold for delinquent taxes recently and the new owners have started to reopen the No. 3 tunnel to examine the silica content remaining in the old stopes. Some copper may also be mined, as under present methods low-grade ore left years ago may now be mined at a profit.

▶The Federal Mining & Smelting Co., headquartered in Wallace, has started milling the old mine dumps at the Morning mine, Mullan, to keep the large milling plant in operation. A shortage of miners has seriously cut down mine production, and to meet the drop in tonnage the old mine dumps will be put through the concentrators and worked over, as this material can be handled by power shovels. Premium payments for lead and zinc make it possible to work these low-grade dumps. It is estimated the dumps contain 1,000,000 tons or more of material that may be run through the mill at this time at a profit.

▶The 1,800-ft. drift on the Yankee Girl vein on the 3,100 level of the Sunshine mine, in the Coeur d'Alenes, will soon be completed to the Sunshine Consolidated line. From that point the Sunshine Consolidated has drifted west for 600 ft., most of the distance in commercial silver-antimony-copper ore. With the completion of the drift to the Sun Con line, ventilation will be available for these deep workings, as the work completes more than 6,000 ft. of a triangle, starting from the Sunshine shaft 3,100 station. Production from Sunshine Consolidated, in which Sunshine Mining Co. owns a 50 percent interest, will probably soon be under way.

▶Construction work on a high-tension power line 106 miles long from Emmett to Stibnite, to furnish the Bradley Mining Co. with 66,000 volts of electrical energy for the operation of its tungsten and antimony mines in the Yellow Pine district, is now well advanced. The power should be available at the mines by the middle of September, according to C. J. Strike, Boise, president and manager of the Idaho Power Co. At present the Bradley mines are operated by the use of diesel engines, which permit of only two-thirds of the plant capacity. The new power-line construction is through difficult timber and snow country with elevations up to

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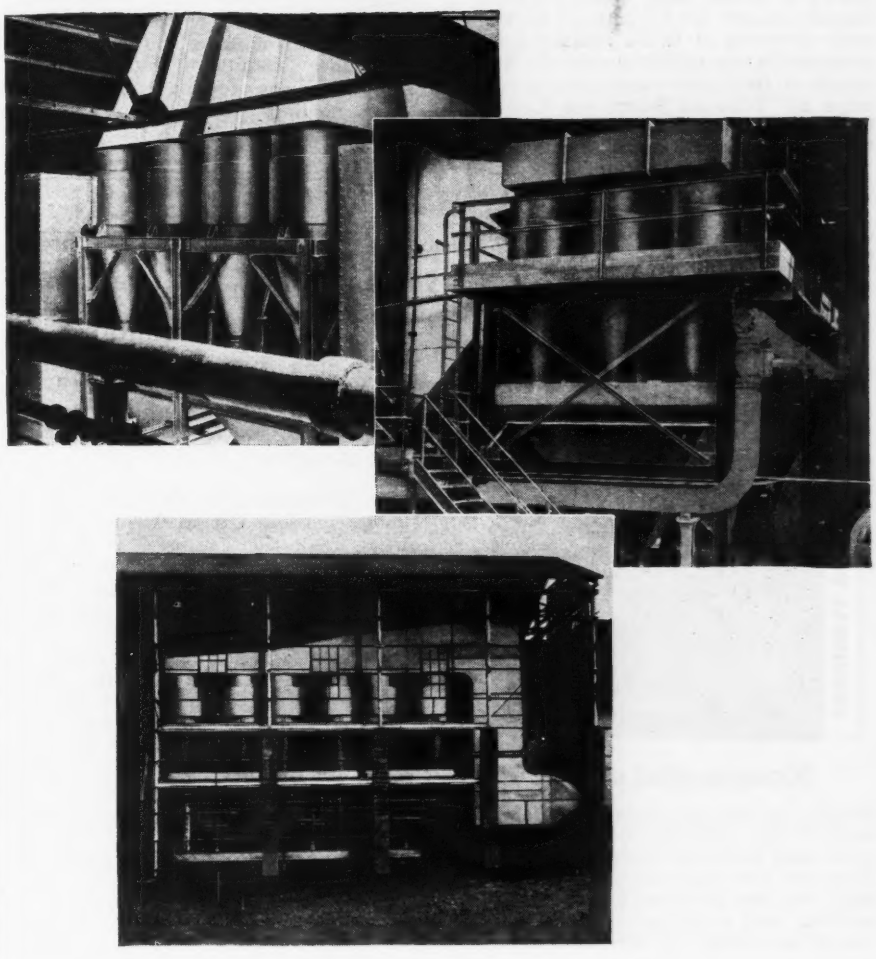

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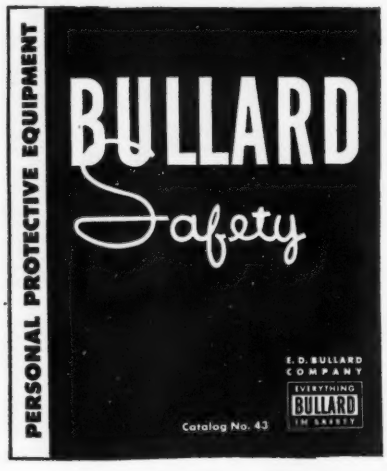

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▶IDAHO

9,000 ft. The Anthony Electric Co., of Los Angeles, has the contract for building the line.

▶ The Nancy Lee mine, in the East Coeur d'Alene district and operated by Kellogg, Idaho, interests, will be ready for production of lead-zinc ore about Aug. 1, according to the company officials. A recent $20,000 federal loan has made possible the reopening of old workings where a large tonnage of ore is available in the King & Queen group. Two other deposits of lead-zinc-copper ore will also be developed on the company's holdings.

WASHINGTON

New Magnesium Plant Starts Production

Manpower bottlenecking production at Metaline Falls—Butler Bros. drilling magnesite deposits—Lone Star mine being rehabilitated

▶ Electrometallurgical Corp., a unit of Union Carbide & Carbon Corp., made its initial production in June, at its new magnesium plant in the State. E. H. Mangan is general superintendent. More than 800 men will be employed when this plant is in full operation. The ferrosilicon process is used. Power is brought from the Grand Coulee dam. The dolomite is coming at the rate of 14 cars a day from quarries five miles from Marble, 100 miles north of Spokane. The quarries have been acquired from the Spokane Portland Cement Co. and ultimately are expected to furnish 20 carloads a day.

▶ Arthur B. Langlie, Governor of Washington, last month inspected the mine development in the northern part of Pend Oreille County, where the chief operations are those of American Zinc, Lead & Smelting Co., and Pend Oreille Mines & Metals Co., and where the U. S. Bureau of Mines is exploring for additional zinc or other war metals. He found that production of zinc would be greatly increased if it were possible to secure additional men. C. A. R. Lambly, superintendent of the Pend Oreille company, informed the Governor that his company would double its output of zinc if 300 additional men could be secured, and American Zinc could also use about the same number of additional men. There has been some shortage of power, but this has been pretty well cared for by additional diesel engines which were installed last month. Operations of American Zinc, Lead & Smelting Co., at its two properties, suffered a 100 percent production curtailment for two months, but are now resumed.

▶ Forty business men from nearby communities were conducted through the quarries and mills of Northwest Magnesite Co., at Chewelah, June 4, by E. A. Garber, manager. An air cooling system makes the temperature comfortable in close proximity to the kilns, operated at 3,200 deg. Six kilns produce 200,000 tons of calcined magnesite, and a seventh, 329 ft. long, with a tapering diameter of 9 ft. 6 in. to 8 ft. 6 in., will produce as much as the other six kilns. A new sink-float plant to handle this magnesite from several quarries will have a capacity of 150 tons per hour and is expected to be in operation in September. C. A. Sargent is general superintendent and Howard Ziebell flotation metallurgist.

▶ Butler Bros., of St. Paul, have taken an option for leases on 20 claims and 480 acres of deeded ground adjoining and adjacent to holdings of Northwest Magnesite Co., 12 miles west of Valley, and are exploring it to determine the extent of its magnesite deposits. Diamond drilling is being done by contract by Sullivan Machinery Co., which has been exploring the ground for several months. Most of the ground is patented. The separate holdings are those of the Double Eagle Magnesite Co., the Crosby interests, the Kulzer claims, and those of J. Richard Brown. It is understood that extensive magnesite deposits are being revealed.

▶ Ross Roundy, a well-known mine operator of Wallace, Idaho, is in charge of operations at the Lone Star mine, near Conconully, Okanogan County, which he has unwatered, cleaned out, and prepared for production of lead-zinc ores. At one time it produced substantial quantities of high grade silver ore. Associated with Mr. Roundy are Judge A. H. Featherstone, Gene Noxon, and others, of Wallace. They are acquiring the property from Chris Barnhart, who opened it to a depth of nearly 400 ft.

▶ Willow Creek Mining Co. has about ten men at its newly acquired "Gorien" property, four miles east of Northport, and is sinking an inclined shaft. At the 200-ft. point a raise will be made to the surface. The shaft is in a good grade of zinc ore 30 ft. wide.

▶ J. F. Goldback reports that U. S. Bureau of Mines examinations of the Empire Granite Co. property, south of Dishman, opened a ledge 300 ft. long and 75 ft. wide containing sugar silica, desired in the manufacture of high-grade refractory brick.

OREGON

Report on Snake River Area is Discouraging

New mill for Bourne mine is near completion—New work on Abeene cinnabar property

▶ Ellis Mining Co. is proceeding steadily on its lease of the Bourne mines, in the Sumpter district, according to John Arthur, superintendent. He expects the new 100-ton gold mill, which is practically completed, to be in opera-

tion in July. The old E and E mill has been rebuilt from the ground up and concrete has been laid for the floors and under the bins. The jaw crusher is linked to a roll crusher with belt feed to the ball-mill supply bin. The plant is being equipped with classifiers, amalgamation, flotation, and two tables. It is expected it will handle ore from some of the adjoining properties.

▶Mineral deposits at the junction of the Snake and Imnaha rivers are the subject of a paper from the State Department of Geology, and are interesting not only to technical men but to all interested in mining. The report gives no hope of finding tungsten deposits in the area. "The reconnaissance failed to show the presence of economic minerals in amounts sufficient to encourage development," says Earl K. Nixon, director of the department. The area investigated includes "Hells Canyon" of the Snake River, the deepest gorge in the United States. The mouth of the Imnaha River is 50 miles up the Snake from Lewiston, Idaho. Mining for copper was done there more than 40 years ago, and the wreck of an old concentrator can still be seen.

▶Freeport Sulphur Co. is investigating mineral deposits of various kinds in the northwestern states and British Columbia, according to David St. Clair, in charge. This company has its western office at Grants Pass.

▶W. F. Kernin, of Roseburg, is in charge of preliminary exploration, 8 miles east of Sutherlin, in Douglas County, where Ed M. Renfro, of Coquille, and associates have acquired the Abeene cinnabar property.

MICHIGAN

Survey Upper Peninsula for Essential Minerals

WPB approves part of White Pine development program—Commission orders wage increase for C & H employees—Quincy obtains reduction in tax valuation

▶The Michigan College of Mining and Technology, in cooperation with the Geological Survey division of the Michigan Department of Conservation, has embarked on an intensive program of strategic mineral investigations in the Upper Peninsula of Michigan. In a well-rounded campaign designed to find more "war materials" in Michigan, in which the federal and state geological surveys and other Michigan educational institutions are actively participating, Michigan Tech's share is a large one, consistent with its special responsibility to the mining industry. Prof. A. K. Snelgrove, head of the department of geological engineering at Michigan Tech, with his colleagues, Profs. W. A. Seaman and V. L. Ayres, assisted by two student compass men, will prospect geologically the borders of the granite masses in Marquette and Baraga counties, including the Huron Mountain area, for ores

From YUBA'S Wartime Mailbag

● A former dredge man now an officer on overseas duty with our armed forces writes to Yuba as follows:

"Pleased to note Yuba is rolling along in high gear on their war production work. It is most gratifying and assuring to us out here to see how American Industry and the American people at home have responded to the national crisis."

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▶MICHIGAN

of tungsten, molybdenum, beryllium, columbium, etc., all of which have expanded wartime uses for alloy purposes. These geologists have already found such minerals in these counties, and their task now will be to locate commercial concentrations of them. Prof. Bart Park, of the Michigan Tech department of chemical engineering, will devote the summer to analytical work on samples collected by the geologists. He will be aided by the department of mineral dressing. This project will be financed jointly by the college and the Geological Survey division of the State Department of Conservation. The college also is desirous to omit no step which will aid the Michigan copper mining industry, and is at present negotiating with Washington authorities for a joint field project which would employ the geophysical apparatus and some of the specialists of the college department of physics in searching for new copper deposits.

▶The War Production Board has approved a partial development of the Copper Range company's White Pine property, in Ontonagon County, and the work has been started. The whole project has eight parts, of which Part I has been approved. The entire program involves the erection of an eight-unit mill at the property, additional shaft sinking, extensive underground development, and an adequate surface plant. Whether the whole project recommended by the Copper Range company is approved by W.P.B. depends on the war outlook. If the war continues beyond this year, it is expected that full approval will be forthcoming. The part of the program approved includes the sinking of a shaft in new territory about a mile southeast of the old shafts and the building of a mill unit at the Champion mill of the Copper Range company. According to W. H. Schacht, president and general manager of Copper Range, the company expects to get some production from White Pine by the end of this year. The new shaft will be sunk to a depth of 900 ft. The orebody will be encountered on the 500-ft. level, at which point drifting will be started. Drifts will be driven at each succeeding level. As soon as drifting is under way, copper ore can be transported to the mill. The White Pine property is approximately 60 miles southwest of the Champion mine of the Copper Range company. The copper occurs in two sandstone beds and parting shale underlying the Nonesuch shale. It is understood that the rock is richly impregnated with copper. The metal deposition, however, is finely distributed and will require special methods of extraction. Much research has been done to solve this problem and it is believed methods adopted will prove satisfactory.

▶An increase of 64c. per shift for production and maintenance employees of the Calumet & Hecla Consolidated Copper Co., retroactive to Dec. 16, as agreed upon by the parties concerned, has been directed by the Non-ferrous Metals Commission. The increase was ordered without prejudice to the increase originally granted by the commission. The original increase was $1 per shift; the difference, or 36c. is under consideration by the commission.

▶The valuation of the properties of the Quincy Mining Co. has been determined at $150,000, which is $25,000 under the valuation recommended by Franklin G. Pardee, state appraiser of mines. The State Tax Commission has approved the recommended valuations for all other mining properties in Houghton County.

IRON COUNTRY

Lake Ore Shipments Are Far Behind Schedule

Annual Lake Superior safety meeting held —Michigan mine statistics are published— Cleveland-Cliffs takes over Cambria-Jackson mine

▶Iron ore shipments for May amounted to 10,974,105 tons. Shipments for the year 1943 to date were approximately 8,500,000 tons less than at the corresponding date in 1942. This shortage under the record year of 1942 will be extremely difficult to overcome, but every person connected with the mining and transporting of iron ore is making every effort to make it up. Considerable trouble has been met with weather conditions on the Lakes and in the vicinity of the open pits being extremely unfavorable. Several serious collisions of boats have occurred, two boats having been sunk.

▶Republic Steel Corp. is engaged in development and construction work at the Susquehanna mine, at Hibbing. This new work is necessary for the mining of as much ore as possible in the coming seasons. Stripping operations have been under way for some time, removing overburden along the south side of the pit. A belt conveyor system and crushing plant will be installed, and 15-ton Euclid trucks are now being used on the stripping job. These trucks will eventually replace the electric haulage system now in use in the pit. The crushing plant will be installed in the pit bottom. Crushed and screened product will be transported on a 30-in. belt conveyor through an underground drift to the present hoist shaft, where the ore will be hoisted to surface and dumped into railroad cars.

▶The E. W. Coons Co., of Hibbing, has commenced stripping the North Julia property, at Virginia. It is hoped that shipments from this mine will start about Aug. 1.

▶The 20th Annual Conference of the Lake Superior Mining Section of the National Safety Council was held in Duluth on June 17 and 18. More than 500 attended the meeting, at which there was presented several interesting papers on new safety measures being used throughout the mining industry in this section. C. V. Brannen, of Hibbing, was chairman of the meeting. At the conclusion of the session E. A. Anundsen,

of Pickands, Mather & Co., in Duluth, was chosen chairman for 1944. W. T. McCormack, safety engineer for Inland Steel Co. at Ishpeming, Mich., was elected vice chairman for the coming year.

▶The annual compilation of statistics covering Michigan iron mines, by F. G. Pardee, has been released by the state geological survey. The figures include tonnage mined, by mines; production, employment, wage and tax statistics; a detailed statement of mining costs, by districts; and the amounts stockpiled, by districts.

▶On June 1 Cleveland-Cliffs Iron Co. took over the operation of the Cambria-Jackson mine, in the Negaunee district of the Marquette Range, from the Republic Steel Corp., with no interruption in the production of iron ore from the mine. This is the only mine operated by Republic on this range. Some changes were made in the operating personnel: W. W. Graff, district superintendent of Negaunee mines for the Cliffs, was placed in general charge, with John Trosvig, of the mining engineering department, appointed assistant superintendent. John B. T. Tregonning is mine captain and Serle Bath is master mechanic. Most of the ore from this shaft comes from a high-grade deposit on the Jackson mine, adjoining the Cambria on the south and leased to Republic over a year ago. This shaft may be used by the new operator as a second outlet from the 1,700-ft. level of its new Mather mine.

▶A long-term investigation of iron-ore resources in the Crystal Falls Iron River district has been started under state and federal geological surveys. Two federal geologists, Dr. F. C. Park, Jr., and C. E. Dutton, collaborating with F. G. Pardee, state mine appraiser, are doing this work. Information for up-to-date base maps is being secured by taking aerial photographs of the Menominee Range. It is hoped that other desired metals so far overlooked may be located. The Michigan College of Mines and Technology will assist in the chemical work needed on the iron-ore formation. This stimulus for new field projects originated from the Upper Peninsula Industrial Conference held in November, 1942, at Houghton, Mich., when joint plans for increasing Michigan's contribution to the mineral war chest were made by the four state schools: University of Michigan; Michigan State College; Michigan College of Mining and Technology, and Wayne University of Detroit. Oil developments as well as copper resources will be included in these surveys.

▶The 66-in. diameter borehole being sunk at the Carey mine of the Pickands Mather Co. near Hurley, Wis., on the Gogebic Range, is now at a depth of over 1,000 ft. in solid granite and will be continued to at least the 2,500-ft. level. The major problem in sinking this hole is to keep it sufficiently vertical that a horizontal cross-section will keep inside of a 15x20 ft. rectangle. At about 400-ft. depth the hole had shifted to the edge of the rectangle and it was necessary to stop and reset the machine about 5 in. to angle again toward the center. Difference in density of the granite on

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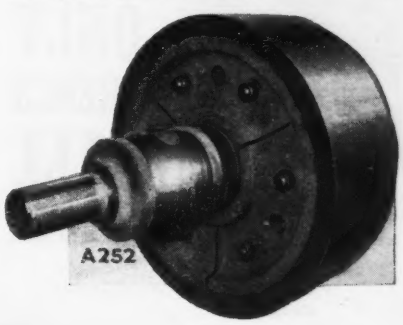

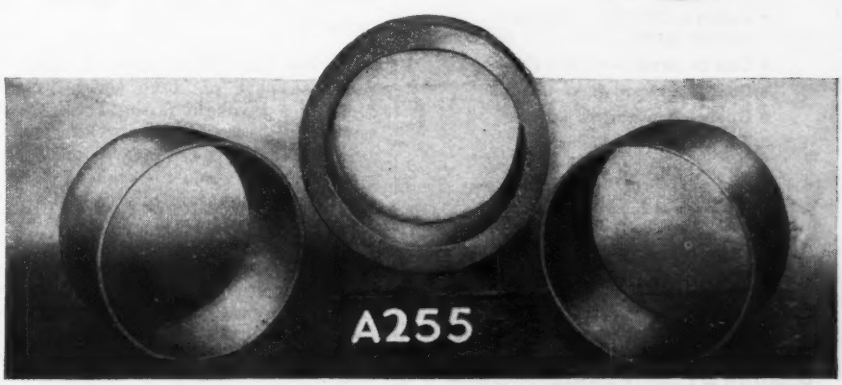

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▶IRON COUNTRY

the four sides of the hole explains why the machine cannot be held on true center at all times. As the hole gets deeper a less dense formation is expected, but so far it has not been encountered. Mr. Lyons, who assisted in sinking a similar hole at the Zenith mine on the Vermilion Range in Minnesota, is in charge of this work, succeeding Mr. Newsom, who has returned to Leland-Stanford University in California.

▶ An unusual request was made to the State Tax Commission at its Ishpeming hearing for the Marquette Range mines on May 18, when Mayor Hampton appeared for the city of Negaunee. He requested that the commission increase the valuation of the mineral holdings lying within the corporate limits of Negaunee by two million dollars, as additional money was needed to operate the city and keep within the budget. His request was refused, as no worthwhile claims were made to substantiate it. During the week the commission held hearings on the three Michigan iron ranges, and announced the tentative valuations placed on the many mineral descriptions. No formal protests were filed, but statements were made by several officials representing the mines emphasizing the fact that high taxation discourages exploration and that if Michigan is going to compete as a future source of ore in the iron industry, the operators must be given, through lower taxes, encouragement to study possibilities of concentration of low-grade ores.

TRI-STATE

Productivity Restored After Flood Damage

Oronogo pit settles an injunction suit—Kansas Explorations opens orebody near Oronogo—F. W. Evans opening three properties

▶ During the latter part of May and the first part of June several mining companies throughout the Tri-State district were required to expend considerable sums in the dewatering of their mine properties and the making of necessary repairs of damages caused by the disastrous May flood. Most of the properties were back in operation by the latter part of June, and production was hitting the pre-flood levels. The only properties where neither mining nor pumping operations had been resumed were those at Oronogo. Preparations were well under way there to launch a major dewatering project when an injunction suit was brought by Mayor Charles Shaw, as mayor of Oronogo, against the Oronogo Mutual Mining Co. and the American Zinc, Lead & Smelting Co., the latter being landowners of the famous open-pit mine at Oronogo. The hearing of the temporary injunction had been set for July 1 in division No. 1 of circuit court in Joplin, and dewatering of the mine to the 90-ft. level by agreement with WPB had been postponed pending outcome of the suit. Complete settlement by mutual agreement was reached, however, on June 30. The city contended in the injunction suit that further blasting and mining operations on the south side of the open pit endangered West Central St., the principal east-west thoroughfare of the town of Oronogo.

▶ Kansas Explorations, Inc., is opening an orebody on the upper level at its new shaft on the Buckingham land, a mile north of Oronogo, according to Ross Blake, of Joplin, district manager for the company. Ore will be trucked to the company's Snapp mill, a mile and one-half to the northwest, where an unloading ramp and incline to the mill hopper are being constructed to facilitate receiving and handling of the ore.

▶ Mine operations have been resumed by the Federal Mining & Smelting Co. at its Oklahoma-Kansas properties in the Picher field, which were closed several weeks following the destruction by fire of the company's Gordon central mill on March 7. Ore from the Lucky Syndicate, Howe, and Lucky Bill mines is being trucked to the Eagle-Picher Bird Dog central mill, a mile west of Picher, and ore from the Kansas properties is being treated over the Youngman mill, a mile northwest of Treece. L. G. Johnson, of Baxter Springs, is district superintendent of the Federal company.

▶ Progress is being shown by the American Zinc, Lead & Smelting Co. in its new mine and mill developments on the Hunter land, a mile southeast of Aurora, according to John J. Inman, of Webb City, district manager of the company. The company has completed a shaft and is carrying on drifting operations from the 210 and 265-ft. levels. Water encountered in sinking the shaft was handled by a 7-in. turbine pump of 500-g.p.m. capacity. A new 35-ton-an-hour mill being constructed by the company near the new mine site is expected to be in operation by the middle or latter part of July. A primary dry-crushing unit is being built in conjunction with a 250-ton hopper at the new shaft derrick, from which a conveyor will carry the crushed ore to the mill hopper of 500-ton capacity, which is divided into two compartments. Milling equipment includes a large crusher, two four-cell rougher jigs, six-cell cleaner jig, necessary rolls and tables, and a Denver Sub-A flotation machine.

▶ With the approval of the Department of Interior of Indian leases on the Adams, Mudd, and Xavier land, F. W. Evans is making preparations to dewater and reopen the mines on the three tracts which comprise 400 acres in the extreme west central part of the Picher field. The original development work on the three adjoining leases was done by the old Anna Beaver Mining Co. 15 years ago. At that time the company, which was backed by Whitney interests in New York, built on the Adams land one of the first all-steel concentration plants in the district, under the supervision of Lee Fillius, Tri-State mine

operator. An electric power line is to be extended to a field shaft on the Adams, where pumps will be installed to dewater the old workings. Upon dewatering of the ground, mine operations will be carried on around the 285-ft. level. The company has completed the deepening of the No. 9 shaft on the old Shorthorn lease, a mile southwest of Cardin, from the 240 to 355-level. A derrick and hopper has been moved to the shaft site, where a railroad extension has been built. Ore will be shipped to the Eagle-Picher Central mill for treatment.

▶As agent for Metals Reserve Co., Brown & Root, Inc., of Houston, Tex., have initiated a churn-drilling project in the north Webb City mining area, according to D. M. Cashin, of Joplin, local representative of the contracting firm. Twelve rigs will be used in the area to test out previous drilling, Cashin said.

▶De Soto Lead & Zinc Co. has placed in operation a new 150-ton concentration plant on the old Valle Mines Co. land, 9 miles southwest of De Soto, Mo., according to George W. Moore, of Joplin. Milling equipment includes a 24-in. crusher, two sets of rolls, two jigs, three sludge tables, and necessary screens. Old mine dumps, containing about 15 percent lead and zinc carbonates on a 5,000-acre lease, are being treated over the mill. The zinc concentrates are expected to run from 35 to 40 percent zinc, and those of lead will average from 76 to 80 percent, Moore said. Mines on the property have been idle since the first World War. Dumps left after free lead had been gleaned are estimated to amount to 400,000 tons and will require several years to re-treat. The old mines were first opened about 50 years ago. Among those associated with Moore in the project are C. D. Raymond and Clyde Lemons.

ARKANSAS

Will Add Waelz Plant to Athletic Smelter

Phos restriction raised for Batesville ore—RFC mining loan granted to Jumbo mine—Quartz crystal lands are withdrawn from mineral entry.

▶Defense Plant Corp. has authorized execution of a contract with Athletic Mining & Smelting Co. for $550,000, which will be used by the company to construct a Waelz kiln at its Fort Smith zinc smelter. The additional unit to the smelting plant will make possible the processing of zinc residues accumulated at the smelter during the last 25 years, according to Charles T. Orr, of Joplin, chairman of the company's board of directors. The Waelz unit will have a capacity of about 200 tons of residues daily, from which a recovery of at least 10 percent zinc is expected, Orr said. Accumulation of residues at the Arkansas smelter amount to approximately 150,000 tons. The company now is treating about 4,000

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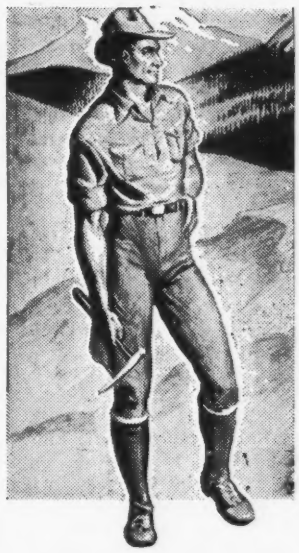

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▶ARKANSAS

tons of zinc concentrates monthly at the smelter, and residues from these also will be treated over the new kiln. Raymond F. Orr, of Fort Smith, who is president of the firm, carried on negotiations with DPC in Washington. Under the contract, the government financing will be repaid out of the returns on the Waelz installation.

▶I. C. Watkins has recently been employed as purchasing agent for the Metals Reserve buying depot at Batesville. OPA removed the phosphorus restriction from manganese ores in the field in April, which opened up a good furnace market for high grade. Recently, the buying depot of Metals Reserve raised this restriction to 1.00. Very little if any ore mined in the field carries as much as 1.00 phos, and this change will open a good local market for high-grade ores running above 35 percent.

▶The Par-Mar, James Wood, of Batesville, operating engineer, is nearly ready for production. By at least July 1 the company should be going strong on its Lafferty Creek property. Its last installation, an 1,800-ft. flume, was completed about the middle of June. It runs from the orebody, which is mined by two big hydraulic nozzles, to the new mill. The ore-bearing clay gouged out by the water, first goes on a belt conveyor, from which all the larger chunks of ore are removed by hand. The finer ore goes into the 1,800-ft. flume and is carried by water to the plant, where it is screened and concentrated. All of the ore produced on the property is high grade.

▶McGee and Little, of Batesville, operating the Gray Hill mine, have their sintering and screening plant all installed on the Bayou in Batesville, except the kiln, which they hope to get in soon.

▶V. C. Johnson and associates, of Batesville, controlling the Polk-Southard mine, near Cushman, are operating a large power shovel, running a big cut around the side of the hill, to a level with former producing shafts. To date they have cut through five runs of high-grade oxide, which will be mined by tunnels from the upper side of the big drift.

▶Buffalo River floods recently drowned out every working property in the Rush district in Marion County. The river peak reached about 60 ft., and flooded the Silver Hollow mine and equipment. The mine has been pumped out, equipment dried out, and it is in production again. The property is operated by the Silver Hollow Mining Co., headed by W. J. Cushing and John Dirst, of Yellville, Silver Hollow produces a high-grade sulphide ore. The ore is being milled at the Edith mill at the mouth of Rush Creek. The mine also has the Silver Queen, but no production has yet been made from it.

▶Rush Creek Mining Co., also headed by W. J. Cushing and John Dirst, of Yellville, has started some exploration work on its properties. These consist of the Lonnie Boy, LaRuh, and White Eagle. The five properties now in the hands of both of these companies have plenty of ore in sight, and if present plans can be carried out successfully, the Rush Creek area should be making an excellent production this fall.

▶Coon Hollow mine, at Zinc, operated by James Rogers, of Harrison, is in operation. Mr. Rogers has completed his exploration work on the orebodies and is making plans to install a milling plant.

▶Excelsior Mining Co., operations in charge of Doyle Palmer, of Harrison, has the Excelsior mine, near St. Joe, pumped out and in operation again. Its mill at this mine is one of three in operation in the field. The company produces a high-grade jack concentrate.

▶Roy F. Wernecke, of Harrison, operating the Jumbo mine, on Buffalo River, in Newton County, has been granted a $5,000 government loan for prospect drilling. He will start drilling operations as soon as he can locate a rig.

▶Newton County Mining & Milling Co., headed by Charles Herman, of Jasper, is installing four tables in its new mill at Jasper, which will complete the plant. The company will mill ore there from its own properties and also do custom milling for small operators in the district.

▶The Arkansas Zinc Co., headed by Jack Manning and Ben Bryant, of Calamine, is installing a big compressor and four drills on its Fugate Hollow mine near Calamine. The company has also taken over the Victory mill, near Eaton, and has been making test runs of its ore from the Fugate Hollow mine, which have proved very satisfactory.

▶Hall Mountain Mining Co., composed of a group of Texas men, including J. C. Jones, W. T. Hall, Fred R. Schmidt, and Milton Harber, has started operating a 1,220 tract of land recently purchased by the company in Marion County. Several mines that were first World War zinc producers are on this property. They include the Truex and Willett mines.

▶Word comes from Washington through Congressman Cravens that the Department of Interior, in cooperation with the General Land Office, has set aside some 1,367 acres in Arkansas' Ouachita National Forest for the mining of quartz crystals. These lands, in Montgomery and Garland counties, have been withdrawn from sale and from public entry. The crystals will be mined by the Metals Reserve Corp., and will be used in two-way radio equipment. The withdrawal of this land will not affect valid existing personal, company, or corporation rights, nor will it affect power development at sites already designated.

▶To determine if there is enough bauxite on the Confederate Home property at Sweet Home to justify the State Bauxite Commission to enter into obligations for a new home for the Civil War veterans, their widows, and daughters, the State Geological Department,

under Joe Kimzey, has made a survey of the property and will report to the commission in a few days. The section of the property where there are no buildings has been surveyed, and if the report is favorable, the buildings will probably not be involved. Drill hole locations have been completed and a complete report is forthcoming.

▶J. R. Thoenen, district engineer of the U. S. Bureau of Mines, has disclosed that the long-idle diamond fields of Arkansas may soon be in operation again. He also reported that holes have been drilled and samples taken. These samples have been sent to Rolla, Mo., for ore dressing and concentrating tests. This exploration is being made at the request of Governor Adkins and the North American Diamond Corp., owner of the largest area.

ALASKA

Dan Creek Property Has Fire Loss

Two new quicksilver developments near Sleetmut—Mines department will continue strategic mineral investigations

▶Dan Creek Mines Co. suffered a serious loss from fire of unknown origin at its property in the Valdez area, according to J. J. Price, manager and one of the owners of the placer ground. The fire started in the mess hall and had made considerable headway before it was discovered. That building, the warehouse, and the offices were burned. Others owners with Mr. Price are Louis Levansaler and Josiah Green, both of Seattle.

▶Livengood Placers, Inc., which did not operate last year, reports a net loss for the 12 months of $105,908. Although the company did not operate its dredge, all necessary work was performed to keep the property in good condition. The company received $12,516 from royalty and profit on the sale of equipment and supplies. Operating expenses were $25,163 and its interest charges were $91,967. Callahan Zinc Lead Co., of Wallace, Idaho, is a 51 percent owner.

▶Alaska gold production was 119,136 oz., in March, according to the U. S. Bureau of Mines. The decline from January is due to the closing of most of the gold mines, leaving the gold production to be that of the byproduct from copper, lead, and zinc ore, which in some mines has increased. A few mines increased their output because of the great demand for silica flux.

▶Quicksilver production will be started by the New York Alaska Dredging Co. on ground near Sleetmut, on the Holitna River, owned by Mr. and Mrs. R. Schafer and Mr. and Mrs. Buck Landru. The dredging company has taken an option on the property, where cinnabar was discovered by Schafer in 1941.

▶Philip S. Smith, chief Alaskan geologist of the U. S. Geological Survey, reports that better transportation facili-

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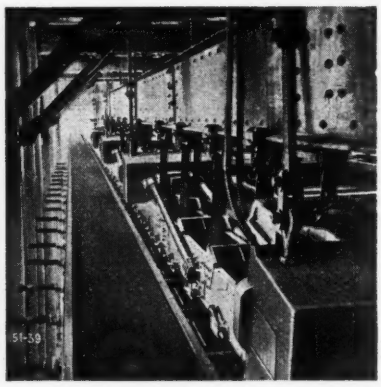
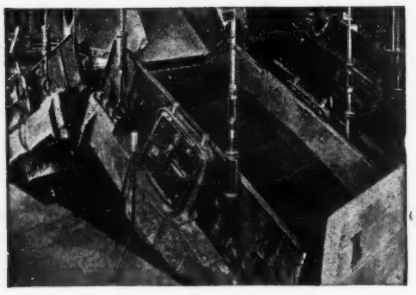
Jeffrey-Traylor grizzly feeder discharging 250 tons per hour to picking belt conveyor. Separation at 3" and fines are by-passed crusher. Also open or totally enclosed pan feeders.



Jeffrey-Traylor reverberatory charging vibrating conveyor equipped with 22 Quick-acting discharge gates—permits rapid charging of furnace. No mechanical wearing parts.



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Jeffrey-Traylor (patented) units provide low cost handling — positive control over tonnage — use balanced high frequency vibration under absolute control. Send for Catalog No. 650.

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▶ALASKA

ties will enable Alaska to produce iron, nickel, arsenic, bismuth, and zinc for war purposes.

▶ B. A. Gould is in charge of the New Idria Alaska Quicksilver Mining Co., in the Sleetmut district, near Flat, which was organized by H. W. Gould interests, of San Francisco, and will develop cinnabar showings.

▶ Treadwell Yukon Co. has paid another liquidation dividend of 10c a share, amounting to $149,258. This brings the total payment to 40c a share.

▶ The Territorial Department of Mines, Henry R. Joesting in charge, will make a survey of strategic mineral deposits in the area between Roundtop Mountain and the Sawtooth Mountains this season. The department also will continue the investigation of tungsten deposits in the Fairbanks district. This work was started last season. Dr. Joesting will make a second report on strategic mineral occurrences in interior Alaska, which will be published by the department, and will be supplemental to one published last year.

in both tungsten and molybdenum. A refined production in 1943 of 827,800 tons of copper, nickel, lead, and zinc is anticipated, compared with an output in 1939 of these four metals amounting to 632,100 tons. Canada's nickel output is 95 percent of the United Nations'; 75 percent of asbestos production; 20 percent of the zinc; 20 percent of the mercury; 12½ percent of the copper; and 15 percent of the lead produced by the United Nations. Wartime Metals Corp., a government agency, has increased production of tin, chrome, manganese, and other metals for the purpose of building up stockpiles. Steel production in Canada has increased to a point five times as great as in 1939. The largest two blast furnaces in the British Empire will reach a combined output within the next month or two of over 2½ million tons a year, an amount almost four times that of 1939.

▶ From late in June to sometime in September mine labor conditions are expected to be unstable in northwestern Quebec and Ontario. Further tonnage cuts are expected this summer by many mine managers. In both Ontario and Northwestern Quebec there has been a steady falling off of workmen. At both the gold and base-metal mines labor shortages have developed as part-time miners returned to farming, either for sowing crops or to clear brush. Between planting and harvesting times, some of these men will return to mining activity for part-time work.

WIB Photo

Delivering preheated charge of dolomite-ferrosilicon briquets to retorts: Dominion Magnesium, Ltd., plant at Renfrew, Ont.

CANADA

Dominion Has Important War Mineral Output

Ontario Nickel begins shipments to Copper Cliff—Permanent B. C. research board is set up—Granby Consolidated signs with C.I.O. union

▶ C. D. Howe, Minister of Munitions in the House of Commons, has rated Canada as the greatest base-metal exporting country in the world. This includes aluminum amounting to about 40 percent of the United Nations' ore requirements, the Canadian process for the output of magnesium, and a self-sufficiency

ONTARIO

▶ By June 15, shipments of ore to the Copper Cliff smelter of International Nickel were started by the Ontario Nickel Corp. The property is on Moose Lake north of the Falconbridge property in MacLellan Township. Before the end of the month it is expected to have production increased to 250 tons a day, following initial daily shipments of 125 tons. The shaft is 250 ft. deep, with the main N.W. drift 3,000 ft. long. Ore shipments are hauled by truck 11

miles to the railroad siding near Garson.

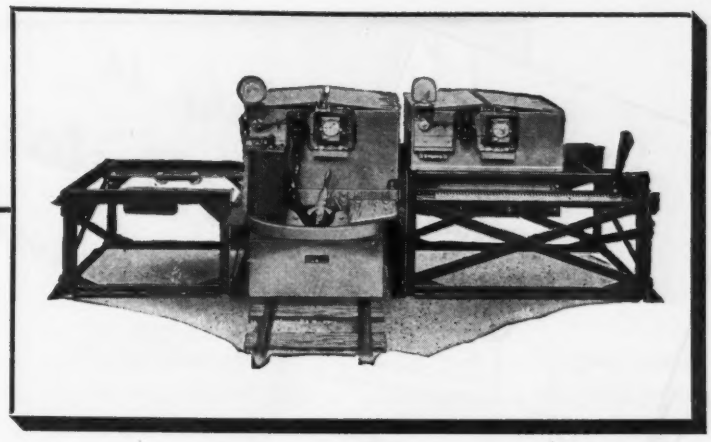
▶Ore described as the best so far developed in the mine has been reported by R. R. Brown, president of Upper Canada Mines. The new showing has been opened for a length of 150 ft. on the deepest level at 1,250 ft. In the course of drifting west on the "H" zone, mineralization averaging an ounce to the ton has been found averaging 5½ ft. in width, and is still in ore to the west. The "H" vein has proved to be the richest opened to date in the mine, with the finest showing on the 875-ft. level, where ore had been developed for a length of about 450 ft. that averaged better than $11 a ton. No pronounced change in structure has been indicated at the lower horizon of 1,250 ft. Two new levels in this area are to be opened by deepening the No. 2 shaft from 350 to 750 ft. Development of veins at shallow horizons in the No. 2 shaft area has reached the point 500 ft. from the west boundary. Additional ground remains to be explored between the No. 1 and No. 2 shafts at the 375-ft. level.

▶At Preston East Dome Mines favorable possibilities have been found for opening up new ore in the porphyry body in the western part of the property. The Preston porphyry mass has developed a good tonnage of ore in the footwall along the greenstone contact, the total length being 152 ft. The ore in this area has a width of 16 ft., being still open at one end. A large porphyry area remains to be explored from the 10th down through the 13th level. The 10th level in the porphyry area is in the process of being opened up and will be followed by exploratory work on the 13th level.

▶Tyranite Mines, near Gowganda and controlled by Sylvanite Gold Mines, has opened a new level by diamond drilling. Ore 12 ft. wide and averaging 4 dwt. of gold has been traced for a length of 200 ft. It is reported that work at the Tyranite was stopped when a working crew could not be maintained for diamond drilling.

▶New ore has been developed by diamond drilling on the 3,125-ft. level at Buffalo Anchorite Gold Mines and is being prepared for mining. Indicated width and gold content show favorable values for a considerable area. May production of 20,000 tons is expected to be improved above 25,000 tons in June.

▶A review of results at Delnite Mines was given by the president, Ed Koons, at the company's annual meeting on June 15th. He said that gold mining had been a major factor in developing Canada to its present industrial status. It will offer employment for returned soldiers after the war. Of the 265 employees at Delnite, 135 are now in the armed services and the remaining 147 employees are keeping the mine in operation. The government was called on to help preserve gold mining as an essential industry during the war period. Liquid assets on June 15 amounted to $408,000. A station is being cut at the 2,000-ft. level and it is proposed to continue shaft sinking to a depth of 2,250 ft., with loading pockets below that point. An effort is being made to keep the milling rate at 350 tons a day.



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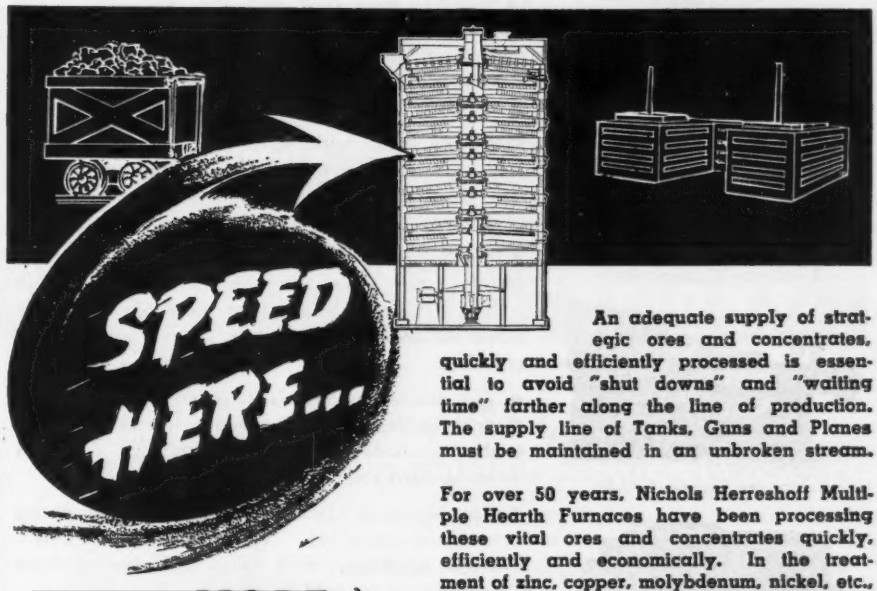

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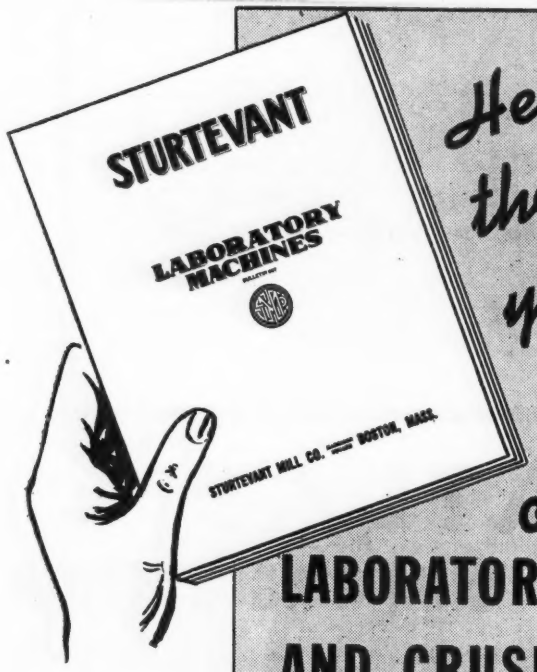

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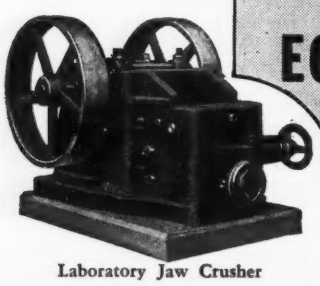
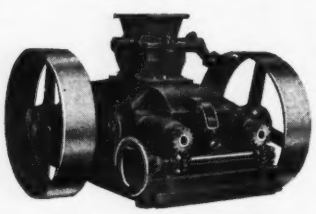
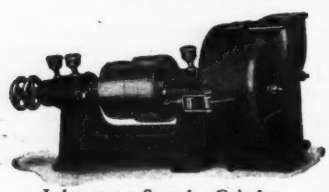


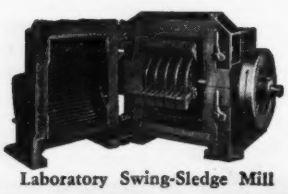
Laboratory Jaw Crusher



Laboratory Crushing Rolls



Laboratory Sample Grinder



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QUEBEC

▶ The annual meeting of Lake Dufault Mines was held at Duparquet on June 15. The president, J. G. MacGregor, announced that the last drill hole cut a 10-ft. section assaying 2.97 percent copper, 1.27 percent zinc, 4.53 oz. silver, and 0.035 oz. gold at a depth of about 1,000 ft. This drill hole is about 160 ft. east of the copper and zinc values described in the annual report and indicates the outlook to be promising at depth. Last year 5,601 ft. of diamond drilling were completed, chiefly from the main haulage level of the Waite Amulet property. At a depth of about 1,050 ft. the main haulage level was run from the Waite Amulet for a distance of 500 ft., which was later extended another 250 ft. Drill holes completed to May 31, 1943, show sulphides replacing the rhyolite-andesite breccia contact at a depth of about 700 ft. below the drill stations. The mineralized zone varies in thickness from 40 to 250 ft. The best of three consecutive holes located 100 ft. apart shows 9 ft. assaying 16.83 percent zinc, and 140 ft. of 2.50 percent zinc. This large deposit is still open to the southeast after showing dimensions 500 ft. long by 300 ft. wide.

▶ Development work at Sladen Malartic Gold Mines has been only partly completed on three of the five new levels. Work remains to be undertaken at the 1,600 and 1,750 ft. horizons. Raises and stopes are being opened above the 1,125 and 1,250 ft. levels in ore that averages lower than current production. Drifting and diamond drilling have maintained an average grade of about $6.50, with 360,000 tons of $4.70 ore added to total reserves of the mine. On the 1,100-ft. level two oreshoots have been explored for combined lengths of 540 ft., including the section open to the east of the shaft, toward the Sladen-East Malartic boundary. On the 1,250-ft. level, ore has been developed for a total length of 609 ft., averaging $5.65, and for about 200 ft. on the 1,400-ft. level, with grade averaging $6.32 across drift width. The average mill schedule of 700 tons a day has been held to and the development program has been largely completed.

▶ The Labrador Mining & Exploration Co. has announced in its annual report by the president, Jules R. Timmins, that 75,000 shares of the company were bought last year by Hollinger Consolidated Gold Mines, at $1 a share. With funds as realized, the Labrador Mining & Exploration Co. paid certain liabilities and bought the remaining 17,504 shares of Newfoundland Skyways, Ltd., which has thus become a fully owned subsidiary. Labrador Mining is indebted to Newfoundland Skyways to the extent of $41,312, according to the balance sheet. Current assets at the end of last year amounted to $42,11[illegible] and current liabilities to $155,964. Liabilities last year included $27,716, which has since been repaid to Hollinger North Shore Exploration Co., and $85,526 advanced from Hollinger Consolidated Gold Mines. Mr. Timmins reported that last year's field work was largely for the purpose of investigating gossans. This

year it is planned to do some diamond drilling. The field party, as in previous seasons since 1936, will be under the direction of Dr. J. A. Retty and will include Walter Thompson, Wilfrid Hyland, and Reinhold Petersen, of Rouyn. The field party of about 20 men will travel as far as Rimouski by train, go by boat to Seven Islands, and from there northward beyond the height of land by plane.

BRITISH COLUMBIA

▶The scope of the War Metals Research Board is being extended and a new board has been created as the nucleus to a permanent organization for industrial research. This move has been made at the instigation of the Hon. E. C. Carson, Minister of the departments of Mines, and of Trade and Industry in the British Columbia government, who has advised the *Engineering and Mining Journal* of the following outline:

(a) Collaboration between the University of British Columbia, the federal Department of Mines and Resources and its branches, and the British Columbia departments of Mines, and Trade and Industry.

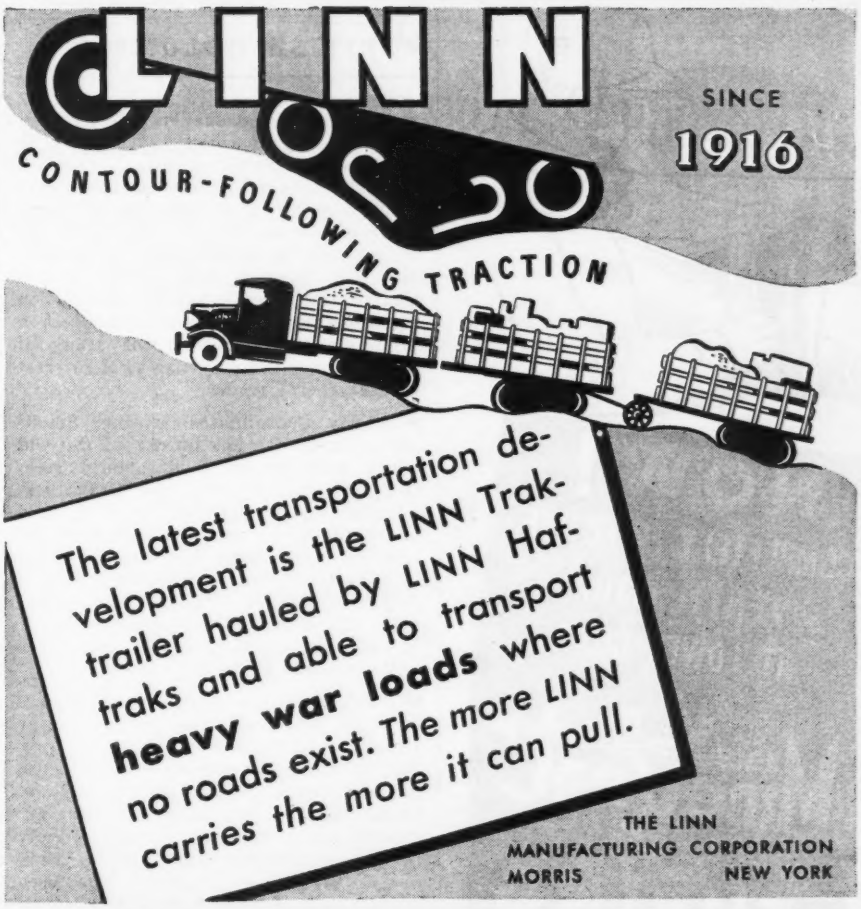
(b) The Dominion will contribute $5,000 annually, the British Columbia Department of Mines, $5,000, and the British Columbia Department of Trade and Industry, $2,500. Additional revenue is expected from industry.

(c) The work formerly undertaken by the British Columbia War Metals Research Board will be extended to include other essential research projects.

J. N. Finlayson, dean of the faculty of Applied Science and head of the Department of Civil Engineering at the University of British Columbia, will be chairman of the new board. The provincial government will be represented by Dr. J. F. Walker, Deputy Minister of Mines, and R. S. O'Meara, Trade Commissioner of the Department of Trade and Industry.

▶A revised edition of Bulletin No. 10, "Tungsten Deposits of British Columbia," has been released by the provincial Department of Mines. Expansion and revision of the original bulletin, published in 1941, was made necessary by the many new discoveries of scheelite during the past two years, discoveries which have altered the search for certain types of deposit. The various data are brought as much as possible up to date of March 31, 1943. As in the former case, the revised edition is almost entirely the work of Dr. John S. Stevenson. One section, "Hints to Prospectors," is included in the hope that it may prove helpful in the search for new deposits, particularly those of high-temperature replacement type.

▶Another recent publication of the British Columbia Department of Mines is Bulletin No. 17, "An Introduction to Metal Mining in British Columbia." This is intended to provide an outline of metal mining in the province. It is written to serve as a background for more particular study. For that reason an historical summary is included, as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▶BRITISH COLUMBIA

well as brief sections on geology, ore-dressing, and metallurgy. The Hon. E. C. Carson, Minister of Mines, states:

"This bulletin is issued in response to many requests for information of a non-technical nature that are constantly being received from the public in general, and from tourists and schools in particular. It is hoped that the information contained therein may be helpful in a preliminary approach to the study of metal mining and may also be of interest to the general reader."

▶Granby Consolidated Mining, Smelting & Power Co. has purchased the Old Glory property on Hellroaring Creek, from Harold Bennett, of Cranbrook. Scheelite and wolframite were discovered on the property in 1942, some of the samples taken being reported very high in tungsten. Tungsten outcrops over a length of 2,000 ft. The ore also carries gold. According to D. M. Cannon, Granby mining engineer, active operations will commence at once.

▶Twin "J" Mines, Ltd., expects to have its Tyee copper-gold-zinc property, near Duncan, on Vancouver Island, in production before the end of June. The new 150-ton mill is ready for use and underground development has been advanced to a point where a steady supply of ore is available. The opening previously planned for June 15 has been postponed because of difficulty in effecting a power connection with existing utility companies. The Twin "J" company is owned 62½ percent by Jason Mines, Ltd., Ontario gold producer, and 37½ per cent by the former shareholders of Tyee Consolidated Mines, Ltd., the latter company being now in liquidation. The operation is being financed by Wartime Metals Corp. on a cost-plus basis.

▶The "Little Billy" and adjoining copper-gold claims on Texada Island, in the Nanaimo mining division are being developed with a view to production by a newly incorporated company, Industrial Mining & Metals Co., Ltd. Prior to the turn of the century these claims were worked and copper ore valued at more than $8,000,000 was shipped. Subsequent operations proved unsuccessful. L. A. Prosser is general manager of the new company and A. G. Langley is mine manager. The properties were reportedly purchased for cash.

▶Pioneer Gold Mines of British Columbia, Ltd., Bridge River district, produced 25,920 oz. gold and 4,812 oz. silver, valued at $998,994, from 60,811 tons, averaging 0.439 oz. gold per ton, in the fiscal year ended March 31, 1943. Production costs, including mining and development, mineral tax, transportation, milling, refining, marketing, and administration, were $557,032. Provision for depreciation was $108,596; for exploration and prospecting, $45,891; for depletion, $27,009; and for income and excess profits taxes, $101,969. Net profit for the year was $224,022 as against dividend payments aggregating $227,728. Development work consisted of 1,580 ft. of drifting, 261 ft. of crosscutting, 604 ft. of raising, and 5,559 ft. of diamond drilling. The acute shortage of labor compelled a sharp curtailment in development work. Ore reserves were estimated, on March 31st, 1943, at 213,842 tons, averaging 0.433 oz. gold per ton, including 53,431 tons of broken ore. Shareholders were informed at the annual meeting that the Bridge River gold-mining operation, at one time the most productive in the province, would be continued and that Ottawa authorities had been convinced of the necessity for its survival. Dr. H. T. James, managing director, states: "Approximately 40 percent of positive ore in place is so situated that it should not be mined until near the end of the operation. The remaining 60 percent will, therefore, have to carry the mine until the labor supply is again adequate and govern the scale of operation until the ore reserves are restored or their limitation established." The search for new properties is being continued.

▶The Granby Consolidated Mining, Smelting & Power Co., Ltd., has signed an agreement recognizing the International Union of Mine, Mill and Smelter Workers as the official bargaining agency for employees at the Copper Mountain mine and the Allenby concentrator. The agreement is for one year but is subject to cancellation within that period should Wartime Metals Corporation discontinue the purchase of copper concentrate on a cost-plus basis. The agreement is also subject to the requirements of union membership under the Provincial Industrial and Conciliation Arbitration Act. The "checkoff" for the collection of union dues is granted, but there is no suggestion of a "closed shop." No provision is made for overtime pay or vacations with pay, although both were discussed during the negotiations preceding the completion of the agreement. These matters have been referred to the National War Labor Board and Wartime Metals Corp. A. S. Baillie, vice-president and general manager of Granby, states that the company has no objection to the payment of time and one-half for work in excess of eight hours per day or 48 hours per week. The company does not object to vacations with pay so long as there remain 300 working days per year. Indeed, officials rather favor the latter request in the hope that it will prove a deterrent to the growth of absenteeism.

▶All assets of Beaver Silver Mines, Ltd., including silver claims on Wallace Mountain in the Greenwood mining division, have been sold to Highland-Bell, Ltd., silver producer, with which Beaver Silver has been closely associated since its incorporation in 1926. The $48,000 received will be distributed in the form of a dividend of 3c. per share.

▶Following the resumption of milling operations on May 17, Sheep Creek Gold Mines, Ltd., leading Nelson district producer, recovered gold valued at $39,672 from 2,062 tons, averaging $19.24 per ton, in the remainder of the month. As a result of the labor shortage it had become necessary to halt milling to advance underground development.

▶Granby Consolidated Mining, Smelting and Power Co., Ltd., has taken an

option on the Old Glory tungsten group, in the Cranbrook area. A crew is already at the property to explore the possibilities.

YUKON TERRITORY

▶All five dredges, the full number proposed to operate this season, are now at work for The Yukon Consolidated Gold Corp., Ltd. In previous seasons ten dredges have been operated but this year mining is being limited to conform to the available labor supply. Shareholders of the Treadwell Yukon Corporation, Ltd., received another liquidation dividend of 10c per share on May 28. The disbursement involved payment of $149,258, and brings total payments to 40c. per share.

MEXICO

Railway Car Shortage Eased for Mines

New decision increases occupational disease liability — Case against alleged smugglers to Japan dismissed—Companía de Guadalupe resumes operation

▶Summer found Mexican mining generally good, with increased production and exports and much less labor trouble. Labor, though, continues to be a problem, but mostly for the smaller companies. The federal board of conciliation has nearly 6,000 indemnification claims, all from miners, the majority of them for compensation for work incapacity from such occupational diseases as silicosis and tuberculosis. However, the industry is free from strikes at present.

▶The National Railways, Mexico's largest railroad, reports that it is doing its utmost to provide rolling stock for mining. That announcement is verified by the lack of complaints from the industry regarding a car shortage, though such kicks continue from some other industries and agriculture. Asarco has taken direct action to handle transportation problems for its Xichu unit. It is reconditioning and improving the old road between Xichu and San Luis de la Paz, a distribution center, both in Guanajuato.

▶President Manuel Avila Camacho has directed the Ministry of National Economy to delivery to the National Commission for Stimulation of the Mining Industry all machinery, laboratory equipment, and warehouse supplies connected with mining that are controlled by the Ministry's central laboratory. The President explained that this order is in accordance with his government's policy to do all possible to increase mining production, as that is a vital part of Mexico's war effort.

▶The Credito Mineria y Mercantil, S. A., Mexico's pioneer mining bank, after investigating steadily soaring living costs in the republic, particularly

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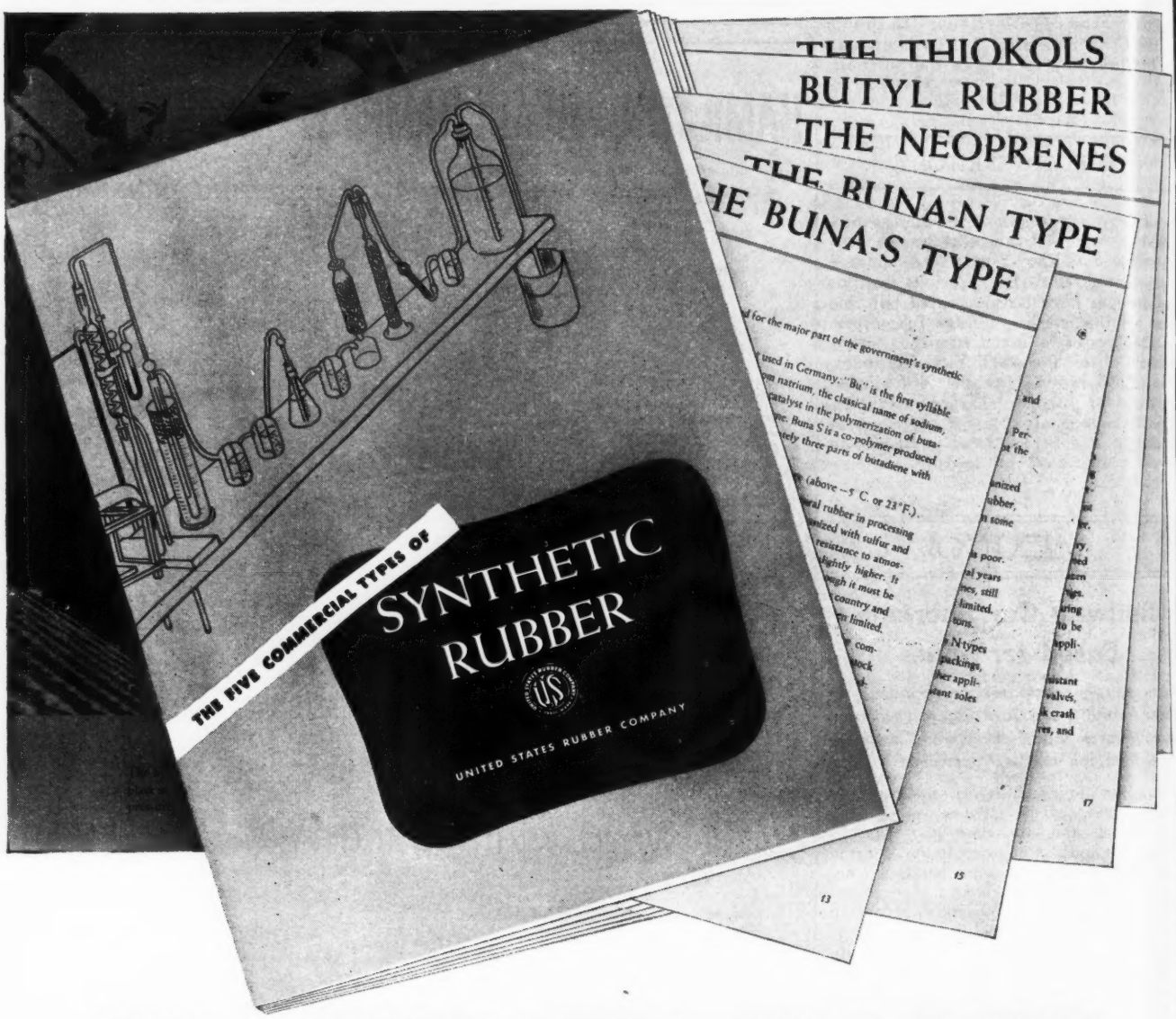

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▶MEXICO

of foodstuff and prime necessity articles, reports that the current purchasing value of the peso, Mexico's monetary unit, is only 49 centavos, compared to its nearly par worth of 100 centavos in 1929.

▶The Guanajuato government and the Ministry of National Economy, which has under its jurisdiction all cooperative societies in Mexico, are straightening out difficulties of the Santa Fe mining cooperative, arising from what its members said was the theft of more than 50,000 pesos ($10,350) of its funds by three officers who were forced to resign. This embezzlement, the society said, has been a serious setback in its activities.

▶The Supreme Court, has rendered a new interpretation of a clause of the federal labor law that may have a far-reaching affect on mining labor indemnification claims. This interpretation was made with the denial of the injunction asked by Neg. Minera de Santa Maria de La Paz y Anexas, S. A., Villa de la Paz, San Luis Potosi, to upset orders of the federal board of conciliation and arbitration that it pay a miner compensation for work incapacity from an occupational disease. The company contended that the man had failed to make his claim within the year after suffering the incapacity that it argued the law demands. The court ruled that the law does not specify that such claims must be made within a year, but within a reasonable time after the claimant is incapacitated.

▶The case of attempted wholesale smuggling to Japan of mercury, antimony, and some other vital metals shortly before Pearl Harbor, an alleged offense that violated Mexico's agreement with the United States, made on July 10, 1941, that she would not permit the sale of mining and some other products needed for the war effort to the Axis powers, has apparently ended. The first district court of Colima canceled charges against the five men arrested in this case, on the ground that there was insufficient evidence against them. The men had been arrested in Tampico and Manzanillo, where the alleged plot was discovered, but were released on cash bail they posted. The court ordered this bail refunded to the men.

▶Agrarians of the Chilpa region, Oaxaca, have sent to the National Commission for Stimulation of the Mining Industry samples of silver and antimony they say they discovered while plowing their property. The zone is near a railroad and a trunk highway.

▶Unprofitable operation forced suspension of work by the Cia. Micas, S. A., Roberto C. Garcia, manager, operator of mica mines in Oaxaca. The employees were paid an indemnification for dismissal.

▶Section No. 2 of the national miners union, composed of Pachuca, Hidalgo, workers, has asked the Labor Ministry to formally recognize officers of the section who it says were elected on April 11 by a majority of votes. The section

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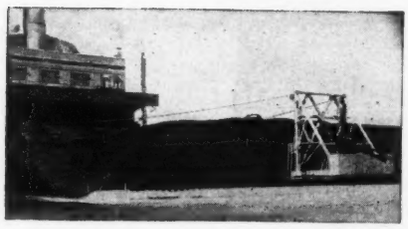

Above is a typical example of a Sauerman Scraper installation of large capacity with self-propelled tail tower as used at mines and processing plants for open storage of materials. This type of machine is able to cover a wide storage area, and handle a large tonnage both storing and reclaiming.

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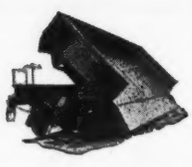

PRESSED STEEL CAR COMPANY, INC.
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▶MEXICO

declared that some miners and their employers refuse to recognize the new officers.

▶ Police of Pachuca, Hidalgo, recovered for the Dos Carlos mining cooperative society the 390 kg. of mercury it had complained had been stolen. An arrest was made in connection with the theft. Efforts to eliminate ore stealing, long a costly practice for the industry, have been intensified by the federal, state, and municipal governments in the principal mining zones. Mining men and the miners union are to participate in the campaign.

▶ The Cia. Minera de Guadalupe, S. A., Sultepec, State of Mexico, has resumed work after a short shutdown, under an agreement with its employees that is intended to enable it to weather a difficult economic period.

▶ Investigation is being made by the National Commission for Stimulation of the Mining Industry of reports of a rich gold strike on property owned by Jose Garcia Lopez, near Perote, the Vera Cruz concentration camp for dangerous enemy aliens. Important deposits of iron and aluminum are said to have been found with that of the gold. Magnesium exploitation has been started on a considerable scale in the Casas Grandes district, Chihuahua, where an important deposit was recently discovered.

▶ Fresh work difficulties confront the Cia. Minera El Fenomeno, S. A., Ensenada, Baja California, with the complaint to the Labor Ministry by its employees that it dismissed three workers without justification and refuses to allow the others free medical services and medicines. The company told the ministry that it was obliged to dismiss the three men because they were agitators. This company recently granted a 15 percent pay hike.

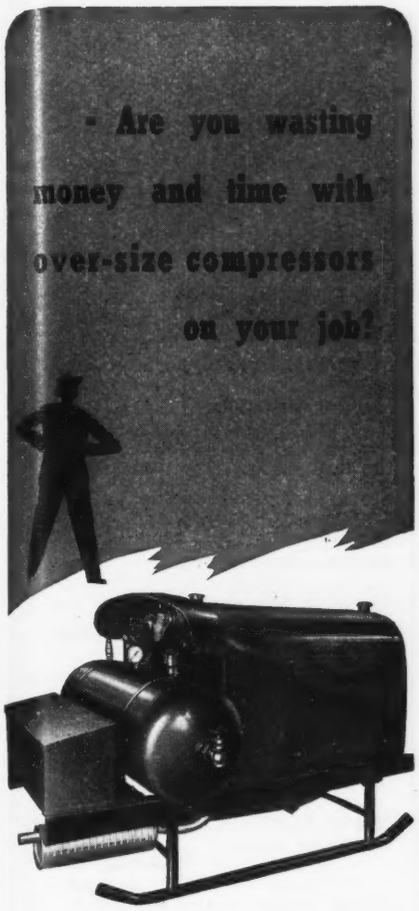
▶ Roads in key mining zones, it is learned, are to receive preferred building and reconditioning preference, with increased expenditures for this work by the federal government, with President Manuel Avila Camacho's orders to increase by 26,500,000 pesos ($5,500,000) the 1943 issue of highway bonds of the United Mexican States. The proceeds from the sales of these bonds are to be devoted to road works in various parts of Mexico.

AFRICA

Rand Retains Good Ore Reserves

Tax burdens and labor shortage are sources of difficulty—Selection Trust increases dividend—Complaint over non-recognition of depletion problem

▶ Returns so far received of operating results during May of the gold mines of the Witwatersrand, in South Africa, indicate a slight upward trend in the



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volume of production, compared with April, and a reduction from that of March. There is, however, far more irregularity in the results than is usual. A number of the newer mines increased both their crushings and gold output, which seems to indicate that the native labor supply is again increasing and that the returning men are going to the mines in which they consider working conditions most pleasing. At least two of the newer mines, Blyvoor and Western Reefs, put through a substantially larger tonnage of ore and set up new high records of gold output. Several of the others produced more gold in May than in March, and East Geduld and Grootvlei which made new high records in March, were only slightly below those record outputs in May.

The final figures are that April production was 1,075,363 oz. of gold, or 33,426 oz. less than in the day longer month of March. It is 107,315 less than in the corresponding month a year ago and was 160,469 oz. less than the high record of all time. The number of native workers is now 315,746, which is 55,286 fewer than a year ago. This decrease in the labor force accounts for the falling off in production during the past year.

▶ The Transvaal Chamber of Mines has established a war damage pool of £2,000,000 to meet any damage to the mine property of its members.

▶ Despite the decreased development footage, dictated by the war, ore reserves showed no alarming shrinkage. East Rand Propriety closed the year with 9,986,000 tons averaging 4-7 dwt., a decrease of only 259,500 tons. Crown Mines developed 1,322,700 tons and reduced total tonnage to 17,194,300, a decrease of 2,327,200 tons. City Deep's tonnage in reserve is down to 3,693,000 tons, dropping 420,900 during the year, though new ore developed totaled 510,300 tons. Simmer & Jack's reserves were down 378,000 tons, at a little over 3,000,000 tons. War has brought about just such a condition as was contemplated while the huge reserves were being built up, and the decreases amount to no more than can readily be spared. By reducing advance development, the shortage of labor and supplies is thus being in part offset.

▶ The South African government has appointed a commission to examine natives' wages and conditions of employment. The Transvaal Chamber of Mines has stated to this commission that cash wages paid to 300,000 natives average 2s. 3 d per shift, and that housing, food, medical and hospital treatment, and other benefits come to 2s. 2½d. per shift. This is a total of about $1.25 per day. Independent engineers who have had experience in the district entertain different opinions as to whether the natives are worth more or less. Some, they agree, are worth much more.

▶ P. M. Anderson, presiding at the meetings of four Witwatersrand companies of which he is chairman, all held at Johannesburg, stated what their earnings and provisions for taxation were for the first quarter of the cnurrent fiscal year. Inclusion of the special taxation recently provided for in his figures makes this statement interesting. The

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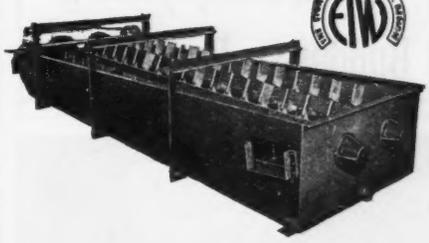

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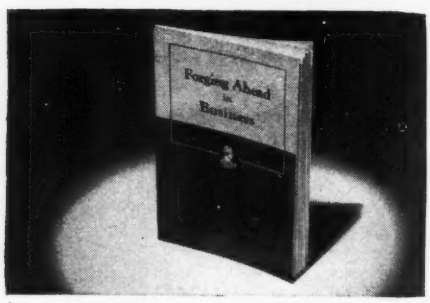

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▶AFRICA

first quarter's profits totaled £1,444,758 and the four companies will together pay, or they expect to pay, out of this, £926,000, or over 64 percent. One of them. Van Dyk, pays slightly less than half of its working profit. The other three, East Geduld, Geduld Propriety, and Marievale, pay substantially more than half. Shortage of labor is making it impossible for these mines to supply their mills fully with ore. Inability to run at capacity thus explains the falling off in the district's monthly production.

▶New Union Goldfields, Ltd., and associated interests are purchasing from Anglo American Corporation of South Africa and Transvaal & Delagor Bay Co., their holdings in the East Rand Gold Coal & Estate Co., Ltd. New Union Goldfields, of which Norbert Erleigh is chairman, is a £320,000 company at present but is expanding its activities. A few months ago it acquired control of the New Vaal River Diamond Co.

▶Nchanga Consolidated Copper's offering of 412,696 shares of £1 8s. 6d. each was taken up to the extent of 98.15 percent, only 1.85 percent being left with the underwriters. This provides Nchanga with the funds required for plant erection.

▶Selection Trust, Ltd., A. Chester Beatty's big exploration and finance company, has increased its dividend, paying 8¾ percent on its 10s. shares this year, against 7½ percent the two previous years. Its holdings of the shares of other companies have risen so greatly in price that a larger payment had been expected. Konongo Gold is paying 6¼ percent this year, the same as for two years previously. Rio Tinto, the big copper and sulphur mine in Spain, reports total income for 1942 of £769,882, against £494,117 the year before, despite its dividend income from its large holdings of Rhokana Copper having been reduced by half. Taxation and expenses in Spain and England took £537,431, against £330,158. For dividends, £139,643 was left, against £66,455 in 1941. The great improvement was partly due to the peseta (Spanish currency) balance built up in previous years having been converted into £194,660 sterling. Rio Tinto is in a strong position, with £237,494 cash and investments worth now more than their book value of £3,463,666. Lord Geddes, the chairman, said at the meeting that the exploration and development of the Northern Rhodesia copper field had necessitated the expenditure of approximately £40,000,000, and asked if it was thought possible for a political bureaucracy to have done it. The copper and cobalt output of those mines was essential to the war effort. In his opinion the British technical organization and whole business of opening mines in other countries is endangered by the income taxation which regards income from ore exhaustion as a portion of the operating profit of mining companies. In every dividend paid is contained, he said, an element of return of capital. This matter is being given wide consideration.

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BULLETIN 551 FOR DATA

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Record 1942 Production Used Fewer Men

ACCORDING to the U. S. Bureau of Mines, with a smaller working force in 1942, the United States produced in dollar values 10 percent more mineral products than in 1941 and exceeded the all-time high year of 1920 by 8 percent. The total value of all mineral products last year—the first full year of United States participation in the present war—was more than 7½ billion dollars. This record performance was accomplished in the face of a manpower reduction in the mineral industries reported at 3 percent under 1941, 26 percent below 1920, and 30 percent under the peak employment and war year of 1917.

While the mineral industries were in operation over a larger number of workdays during 1942 than during 1941, it is probable that the chief explanation of the ability of these industries to meet the needs of the nation for iron, copper, coal, and other minerals with a notably smaller working personnel in recent years than in earlier years is the great advance in mechanization. The replacement of hand methods by mechanized methods of operation, and the improvement in organization and coordination of effort that often follows mechanization, have greatly increased the productivity of labor per man-hour of work, and it is this fact, as stated, perhaps more than any other single factor, that accounts for a marked increase in production in the face of a decrease in manpower.

Inland Steel Takes Over Fluorspar Operation

ON JUNE 1 the Inland Steel Co. purchased all the capital stock of the Hillside Fluor Spar Mines and assumed operation of the company's mines at Rosiclare, Ill.

It was announced that the Hillside company will continue to be operated as a separte unit, with no changes in its general policies, and its acquisition will not alter the plan of serving other companies, which, along with Inland, have been supplied by the mines.

The company was founded in August, 1919, by the late G. H. Jones, who controlled and operated the mines until his death, on July 6, 1941.

H. W. Hurst will continue as general superintendent at the operating office of the company in Rosiclare.

National Will Enlarge MacIntyre Plant

CONTRACT has been let to Turner Construction Co. for an addition to the MacIntyre plant of National Lead Co., new titanium operation on the shores of Lake Sanford, in the Adirondack Mountains of New York. The addition, to cost 1.5 million dollars, will be financed and owned by Defense Plant Corp. and will be for the purpose of preparing and sintering the magnetite byproduct of titanium production into a suitable feed for iron blast furnaces. National Lead will operate the plant under lease.

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WHY STOCKPILES—?

(*Continued from page 73*)

stockpile accumulation over more than ten or twelve years. Thus, the acquisition of such a supply by the government could not only take all the domestic output of strategic and critical minerals, including copper, zinc, and lead, for at least four and possibly ten years, but would consume all the known minable domestic reserves of these minerals with the exception of copper. In the case of copper more than half the known minable domestic reserves would be taken.

What the effect would be on the prices consumers would have to pay for their needs, with all or a large portion of domestic production thus tied up for government stockpiling, is entirely problematical, but to throw the world's greatest mineral-consuming nation from a state of approximate self-sufficiency, for peacetime purposes, in regard to copper, zinc, and lead, to one of dependency on foreign sources for commercial needs would be bound to affect both prices and world depletion profoundly. If, in addition, other nations, such as Russia and the British Empire, should take fright at our preparations for war and undertake to do likewise, the effect on supplies and prices could be fantastic.

Another problem which the industry must take into account should some such program of accumulation be put into effect is the probable tendency that would be set up by mineral scarcity and high prices toward driving consumers into a quest for substitutes.

If on the other hand, the Bureau of Mines should decide to certify as "desirable in the public interest and beneficial to the national economy" only the high-cost producers who would otherwise be unable to operate, then the effect on prices and markets would be lessened or eliminated, but the acquisition of the requisite inventories in many cases would take either extremely high prices or several decades of buying at more moderate prices.

Economy Verses Employment

Cleavages in opinion are already apparent with respect to the sources from which stockpiles should be acquired. Many in the industry believe that they should be drawn from the regular channels of trade, and from the cheapest sources, whether foreign or domestic. Obviously, such a course would save taxpayers a tremendous sum. Others are inclined to patronize domestic sources wherever possible, as is contemplated in the Scrugham bill. The extreme view would require sole use of uneconomic domestic sources.

They who would purchase from the cheapest source bolster their viewpoint with the arguments that world economy is already badly askew because of the numerous restrictions imposed upon freedom of trade, that there is a limit to what the taxpayers can stand, and that a willingness to accept foreign raw materials points the only way by which foreign countries can repay lend-lease obligations or the postwar extensions of credit which seem necessary for world rehabilitation. Many in this group are also against the unnecessary depletion of scarce mineral reserves, believing that they are best conserved for a possible future emergency by leaving them in the natural state.

Those favoring the purchase exclusively from domestic sources where possible have the problem of domestic employment uppermost in mind. They reason that, without some form of subsidy, about half the people now employed in domestic mining will lose their jobs, plus the number of men in service who came from the mining industry. They ask, "Would you rather have these people rake leaves, or remain in their natural occupation, producing something of permanent value even if at high cost?" In regard to the depletion of scarce mineral reserves, they point out that a stockpile program is not final depletion but merely a conversion into a more readily usable state.

Coordinated Measures

A logical program of preparing for a possible future emergency would not be confined to mineral stockpiling alone. Any future aggressor would resort to blitzkrieg tactics in any military attack, aimed at paralyzing the victim before it can organize for defense. The success of the Germans in overrunning western Europe indicates how successful such an attack can be, and the growing importance of air power suggests that any future blitzkrieg will be more sudden and devastating than anything yet experienced. Stockpiles are likely to be of little avail if we are not prepared with a national or international defensive force competent to cope with any reasonably possible attack. Thus a natural corollary of a stockpile program is an adequate military force, whether that force be national or international.

If a policy should be adopted of conserving scarce mineral reserves in the natural state, as against exhausting them and stockpiling the products in a quickly usable form, then, as emphasized by Leith, coordinated technical studies should be made, such as the definition of reserves and development of pilot-plant operations, to assure that there will be a minimum of delay in extracting these minerals when they are needed and in using them most efficiently.

Administrative Problems

Many people in the industry, fearing that large mineral inventories in the hands of government might possibly be used as a means of political coercion in the future, would like to devise some method of assuring that stockpiles will be irrevocably reserved for a genuine future emergency. Obviously, legislation cannot accomplish this, as Congress can repeal or amend any law. Furthermore, there would seem to be no practical plan by which the people or their representatives or rulers can be prevented from exercising their will in the future.

Some pin their hopes to the idea that stockpiles would be divorced from politics if they can be placed in the custody of the fighting services. However, a review of the conduct of these departments, either in the past or at present, does not bear out the assumption that they are aloof from politics. Also, the history of their attitude toward stockpiling does not suggest that their ideas are bound to parallel those of the mineral industry.

To assume that anything done by government can be completely insulated from politicians is simply naive. Moreover, there are several problems connected with stockpiling where administrative discretion is virtually necessary. Someone has to determine when a future emergency arrives, and there is no basis for assuming that adequate criteria based on experience alone can be defined by law, leaving nothing to discretion. Then, there is the problem of determining what materials are strategic and critical in a rapidly changing world. At present, for example, we find ourselves closer to embarrassment for lack of minerals we thought we had in ample abundance, such as copper and zinc, than for most of the strategic minerals which we undertook to stockpile before the war. Also, there must be some basis for determining when any material passes out of the strategic and critical classifications, either through new discoveries or technological changes. Certainly the public will not tolerate the perpetual carrying of mineral stocks whose emergency significance has disappeared, simply to please the producers of these materials. Finally, discretion must be exercised in the guidance of any technological studies carried on in connection with stockpiling.

Therefore, it seems apparent that administration by some agency having considerable discretionary power must accompany a workable stockpile program. The industry would be more realistic to bend its efforts toward making such an agency intelligent and efficient, rather than toward the hopeless quest of divorcing anything done by government from political influences.

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Washington Reflections

(*Continued from page* 81)

who stated that the problem was not peculiar to mining and that in his opinion each case should be decided in the courts on its own merits.

Green Silver Bill

ON JUNE 18 the Senate passed the amended Green bill, which provides for sale of Treasury silver as follows:

"the President is authorized, through the Secretary of the Treasury, upon the recommendation of the Chairman of the War Production Board, to sell or lease for domestic purposes for a period of not longer than six months after the cessation of hostilities in the present war, as proclaimed by the President, upon such terms as the Secretary of the Treasury shall deem advisable, to any person, partnership, association, or corporation, or any department of the Government, for purposes, including but not limited to the making of munitions of war and the supplying of civilian needs, and the converting of existing plants to those purposes, any silver held or owned by the United States: Provided, That no silver shall be sold under this act at less than 71.11 cents per fine troy ounce: Provided further, That at all times the ownership and the possession or control within the United States of an amount of silver of a monetary value equal to the face amount of all outstanding silver certificates heretofore or hereafter issued by the Secretary of the Treasury shall be maintained by the Treasury."

The bill will expire on Dec. 31, 1944, and is likely to be accepted by the House in place of the Celler amendment to the Treasury-Post Office bill, which has been unacceptable to the Senate on the grounds that it was not germane to the appropriation bill.

Enormous Foreign Purchases

IN TESTIMONY by Assistant Secretary of Commerce Will Clayton before the Byrd committee, and also in discussions during the hearings of the Senate Mines and Mining Committee on the Scrugham stockpiling bill it was made public that the RFC has spent approximately two billion dollars on the purchase of foreign strategic and critical minerals. For some time these purchases have been negotiated and directed by the Board of Economic Warfare, the part of Metals Reserve Co. having been reduced to paying the bill. Clayton's testimony indicated that RFC opinion was not always in accord with the policies of BEW in making these purchases, which can reasonably be inferred to mean that RFC would have been less lavish in expenditures had it been permitted to exercise its own judgment.

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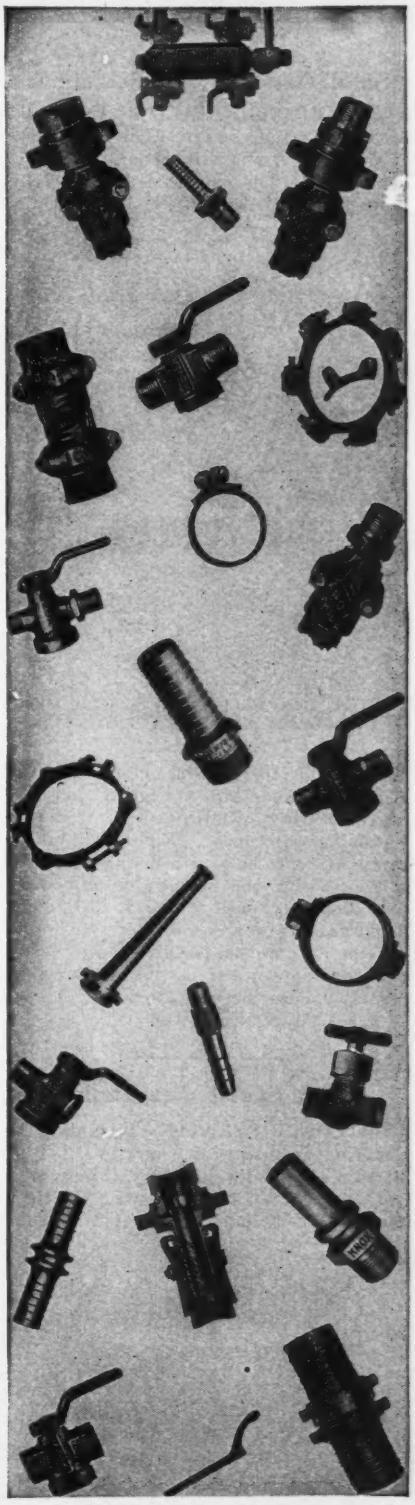

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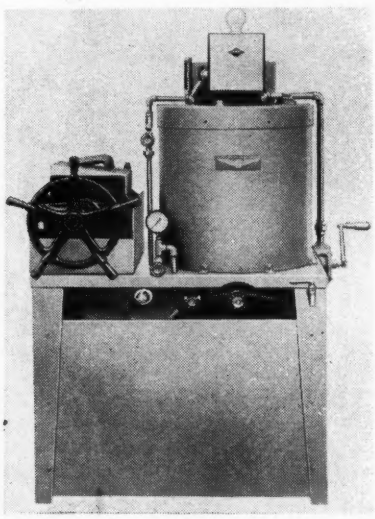
Equipment News

Small-Capacity Oil Reclaimer

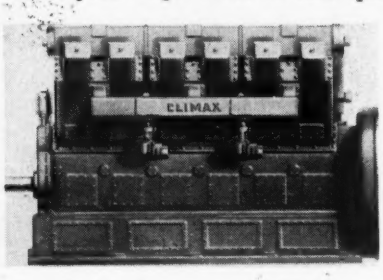
DESIGNED FOR SMALL PLANTS and for organizations having their own fleets of trucks, a new small-capacity lubricating oil reclaimer has been developed by Youngstown Miller Co., Sandusky, Ohio.



In addition to handling motor oil, the reclaimer can clean a limited quantity of lubricating oil drained from manufacturing equipment. Eight gallons of dirty oil can be purified in 70 to 90 minutes with the new unit; and when operated only once a day it will clean 2,500 gallons of waste oil per year. Employing a two-stage filter press and common refinery earths, the machine operates under thermostatic control, the process being semi-automatic.

High Speed Gas Engine

LOW COST OPERATION is said to be achieved in using the new V-12 Blue Streak engine developed by Climax Engineering Co., Clinton, Iowa. With a normal speed range of 600 to 1200 rpm.



and a brake horsepower of 435, the engine will operate equally well on any one of several fuels, such as natural gas, butane, or gasoline. Dual carburetion and ignition are provided, and the cooling system is arranged to give more than adequate protection. The new engine is suggested for driving large pumps or compressors, other mining or construction machinery, and for generating electric power.

Goggle Cleaning Station

TO FACILITATE CLEANING of workmen's goggles, Mine Safety Appliances Co., Pittsburgh, Pa., has designed a goggle-cleaning station which comprises in one unit the elements necessary; namely, a liquid lens-cleaning and antifogging agent and a supply of optical wiping tissues. The convenient dispensing compartment in which these supplies are contained can be mounted on the wall at any suitable location.

INDUSTRIAL NOTES

Army-Navy "E" awards for excellence in the production of war materials were recently given to the following firms: **Sullivan Machinery Co.**, Michigan City, Ind.; the copper refinery of **United States Metals Refining Co.**, Carteret, N. J.; **Universal Engineering Corp.**, Cedar Rapids, Iowa; **E. I. du Pont de Nemours & Co.**, Belin Works, Delaware; and **Climax Engineering Co.**, Clinton, Iowa. "E" awards were renewed at **S. G. Taylor Chain Co.**, Hammond, Ind., and **Stewart-Warner Co.**, Chicago, Ill. **Nordberg Mfg. Co.**, Milwaukee, Wis., was awarded the **Maritime "M" pennant** and **Victory Fleet flag.**

D. A. Robison has resigned as vice president of Caterpillar Tractor Co., Peoria, Ill., to become the company's distributor at Salt Lake City, Utah. **Gail E. Spain** will succeed him.

R. G. LeTourneau, Inc., Peoria, Ill., announces the appointment of **Gordon S. McKenty** as general parts department manager to supervise parts sales, orders, and shipping activities.

Westinghouse Electric & Mfg Co., East Pittsburgh, Pa., announces the appointment of **Herbert G. Dillon** as manager of the newly formed Mining Section of the company's Industrial Department.

Leigh Willard, once an Allis-Chalmers draftsman, was recently elected a company director to fill the vacancy left on the board by the death of **Max W. Babb.** Mr. Willard is also president and director of **Interlake Iron Corp.**, the nation's largest producer of merchant pig iron.

General Refractories Co., Philadelphia, Pa., announces purchase of the assets of **Refractories Corp.**, Los Angeles, Calif., which will hereafter operate as a unit of the former company. **Fred C. Sammons**, formerly vice president of Refractories Corp., will be western manager for General Refractories.

Weston G. Frome has recently been appointed assistant general manager of the explosives department of **Atlas Powder Co.**, Wilmington, Del. He was formerly general manager of the company's Giant Division at San Francisco, Calif.

BULLETINS

Vibrating Equipment. An excellent and comprehensive description of the full line of Jeffrey-Traylor electric vibrating equipment for conveying, screening, ore feeding, drying, packing, and other operations is furnished in a new 176-page book published by Jeffrey Mfg. Co., Columbus, Ohio. Detailed dimension drawings are given of each of the units; full illustrations of typical installations and technical discussions of each type of operation are presented. It is a worth-while addition to the literature on materials handling.

Vertical Pumps. Ingersoll-Rand Co., New York, N. Y., has issued a 20-page booklet describing a line of vertical axial and mixed-flow pumps available in capacities up to 75,000 gpm. and heads up to 100 ft.

Air Tools. Several points to watch in conserving compressed air are described in a series of industrial posters prepared by Ingersoll-Rand Co., New York, N. Y., and all users of rock drills are further offered a supply of printed sheets, Form 2358, to aid in recording repair and maintenance costs.

Control Instruments. Pneumatic control instruments for regulation of pH, conductivity, temperature, and other conditions are described in a new bulletin of Leeds & Northrup Co., Philadelphia, Pa., makers of Micromax instruments.

Power-Transmission Equipment. A new 180-page general catalog of power-transmission equipment has been issued by Link-Belt Co., Chicago, Ill. The desirability of standardizing equipment is stressed in the book.

Safety Equipment Conservation. Maintenance of every type of safety equipment is discussed in a new bulletin of Mine Safety Appliances Co., Pittsburgh, Pa.

Rope Adjustment. Proper adjustment of wire ropes on conical or cylindro-conical hoisting drums is the subject of a bulletin prepared by Vulcan Iron Works, Wilkes-Barre, Pa.

Lathes. The entire line of South Bend engine, toolroom, and turret lathes is described in a new bulletin, No. 100-C, issued by South Bend Lathe Works, South Bend, Ind.

Speed Reducers. Reeves reducer-type transmissions for variable speed reduction are described in a new catalog issued by Reeves Pulley Co., Columbus, Ind.

Welder's Handbook. Oxy-acetylene welding and cutting processes are discussed in a new booklet of International Acetylene Association, 30 East 42d St., New York, N. Y., in which particular emphasis is placed on maintenance of equipment.

Synthetic Rubber. The five commercial types of synthetic rubber are described in a booklet recently published by United States Rubber Co., 1230 Sixth Ave., New York, N. Y.

Koroseal Linings. A catalog section on use of sheet Koroseal for lining tanks made of welded steel, wood, or concrete has been released by B. F. Goodrich Co., Akron, Ohio.